400 MST

ARCMASTER®

INVERTER ARC WELDER

Art # A-07368

Service Manual

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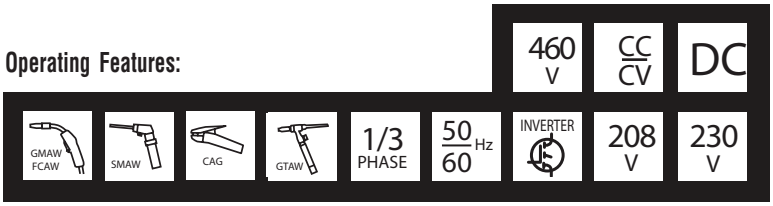
Operating Features:



THERMAL ARC®

WARNINGS

Read and understand this entire Manual and your employer's safety practices before installing, operating, or servicing the equipment.

While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.

ArcMaster 400 MST Inverter Arc Welder
Service Manual Number 0-4944B for:
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Record the following information for Warranty purposes:

Where Purchased: _____

Purchase Date: _____

Equipment Serial #: _____

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7 VOLTAGE REDUCTION DEVICE (VRD)

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1.0 SAFETY INSTRUCTIONS AND WARNINGS

WARNING

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR. DO NOT LOSE THESE INSTRUCTIONS. READ OPERATING/INSTRUCTION MANUAL BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.

Welding products and welding processes can cause serious injury or death, or damage to other equipment or property, if the operator does not strictly observe all safety rules and take precautionary actions.

Safe practices have developed from past experience in the use of welding and cutting. These practices must be learned through study and training before using this equipment. Some of these practices apply to equipment connected to power lines; other practices apply to engine driven equipment. Anyone not having extensive training in welding and cutting practices should not attempt to weld.

Safe practices are outlined in the American National Standard Z49.1 entitled: SAFETY IN WELDING AND CUTTING. This publication and other guides to what you should learn before operating this equipment are listed at the end of these safety precautions. **HAVE ALL INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR WORK PERFORMED ONLY BY QUALIFIED PEOPLE.**

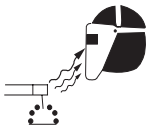
1.01 Arc Welding Hazards

WARNING

ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

1. Do not touch live electrical parts.
2. Wear dry, hole-free insulating gloves and body protection.
3. Insulate yourself from work and ground using dry insulating mats or covers.
4. Disconnect input power or stop engine before installing or servicing this equipment. Lock input power disconnect switch open, or remove line fuses so power cannot be turned on accidentally.
5. Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
6. Turn off all equipment when not in use. Disconnect power to equipment if it will be left unattended or out of service.
7. Use fully insulated electrode holders. Never dip holder in water to cool it or lay it down on the ground or the work surface. Do not touch holders connected to two welding machines at the same time or touch other people with the holder or electrode.
8. Do not use worn, damaged, undersized, or poorly spliced cables.
9. Do not wrap cables around your body.
10. Ground the workpiece to a good electrical (earth) ground.
11. Do not touch electrode while in contact with the work (ground) circuit.
12. Use only well-maintained equipment. Repair or replace damaged parts at once.
13. In confined spaces or damp locations, do not use a welder with AC output unless it is equipped with a voltage reducer. Use equipment with DC output.
14. Wear a safety harness to prevent falling if working above floor level.
15. Keep all panels and covers securely in place.



WARNING

ARC RAYS can burn eyes and skin; NOISE can damage hearing. Arc rays from the welding process produce intense heat and strong ultraviolet rays that can burn eyes and skin. Noise from some processes can damage hearing.

1. Wear a welding helmet fitted with a proper shade of filter (see ANSI Z49.1 listed in Safety Standards) to protect your face and eyes when welding or watching.
2. Wear approved safety glasses. Side shields recommended.

3. Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
4. Wear protective clothing made from durable, flame-resistant material (wool and leather) and foot protection.
5. Use approved ear plugs or ear muffs if noise level is high.

WARNING

FUMES AND GASES can be hazardous to your health.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

1. Keep your head out of the fumes. Do not breath the fumes.
2. If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
3. If ventilation is poor, use an approved air-supplied respirator.
4. Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instruction for metals, consumables, coatings, and cleaners.
5. Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Shielding gases used for welding can displace air causing injury or death. Be sure the breathing air is safe.
6. Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
7. Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.

WARNING

WELDING can cause fire or explosion.

Sparks and spatter fly off from the welding arc. The flying sparks and hot metal, weld spatter, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode or welding wire to metal objects can cause sparks, overheating, or fire.

1. Protect yourself and others from flying sparks and hot metal.
2. Do not weld where flying sparks can strike flammable material.
3. Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
4. Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
5. Watch for fire, and keep a fire extinguisher nearby.
6. Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
7. Do not weld on closed containers such as tanks or drums.
8. Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock and fire hazards.
9. Do not use welder to thaw frozen pipes.
10. Remove stick electrode from holder or cut off welding wire at contact tip when not in use.

Eye protection filter shade selector for welding or cutting (goggles or helmet), from AWS A6.2-73.

Welding or cutting	*Electrode Size*	*Filter*
Torch soldering		2
Torch brazing		3 or 4
Oxygen Cutting		
Light	Under 1 in., 25 mm	3 or 4
Medium	1 to 6 in., 25-150 mm	4 or 5
Heavy	Over 6 in., 150 mm	5 or 6
Gas welding		
Light	Under 1/8 in., 3 mm	4 or 5
Medium	1/8 to 1/2 in., 3-12 mm	5 or 6
Heavy	Over 1/2 in., 12 mm	6 or 8
Shielded metal-arc	Under 5/32 in., 4 mm	10
	5/32 to 1/4 in.,	12
	Over 1/4 in., 6.4 mm	14

Welding or cutting	*Electrode Size*	*Filter*
Gas metal-arc		
Non-ferrous base metal	All	11
Ferrous base metal	All	12
Gas tungsten arc welding	All	12
(TIG)	All	12
Atomic hydrogen welding	All	12
Carbon arc welding	All	12
Plasma arc welding		
Carbon arc air gouging		
Light		12
Heavy		14
Plasma arc cutting		
Light	Under 300 Amp	9
Medium	300 to 400 Amp	12
Heavy	Over 400 Amp	14

WARNING

FLYING SPARKS AND HOT METAL can cause injury.

Chipping and grinding cause flying metal. As welds cool, they can throw off slag.

1. Wear approved face shield or safety goggles. Side shields recommended.
2. Wear proper body protection to protect skin.

WARNING

CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

1. Protect compressed gas cylinders from excessive heat, mechanical shocks, and arcs.
2. Install and secure cylinders in an upright position by chaining them to a stationary support or equipment cylinder rack to prevent falling or tipping.
3. Keep cylinders away from any welding or other electrical circuits.
4. Never allow a welding electrode to touch any cylinder.
5. Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
6. Turn face away from valve outlet when opening cylinder valve.
7. Keep protective cap in place over valve except when cylinder is in use or connected for use.
8. Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in Safety Standards.

WARNING

Engines can be dangerous.

WARNING

ENGINE EXHAUST GASES can kill.

Engines produce harmful exhaust gases.

1. Use equipment outside in open, well-ventilated areas.
2. If used in a closed area, vent engine exhaust outside and away from any building air intakes.

WARNING

ENGINE FUEL can cause fire or explosion.

Engine fuel is highly flammable.

1. Stop engine before checking or adding fuel.
2. Do not add fuel while smoking or if unit is near any sparks or open flames.
3. Allow engine to cool before fueling. If possible, check and add fuel to cold engine before beginning job.
4. Do not overfill tank — allow room for fuel to expand.
5. Do not spill fuel. If fuel is spilled, clean up before starting engine.

WARNING

MOVING PARTS can cause injury.

Moving parts, such as fans, rotors, and belts can cut fingers and hands and catch loose clothing.

1. Keep all doors, panels, covers, and guards closed and securely in place.
2. Stop engine before installing or connecting unit.
3. Have only qualified people remove guards or covers for maintenance and troubleshooting as necessary.
4. To prevent accidental starting during servicing, disconnect negative (-) battery cable from battery.
5. Keep hands, hair, loose clothing, and tools away from moving parts.
6. Reinstall panels or guards and close doors when servicing is finished and before starting engine.

WARNING

SPARKS can cause BATTERY GASES TO EXPLODE; BATTERY ACID can burn eyes and skin.

Batteries contain acid and generate explosive gases.

1. Always wear a face shield when working on a battery.
2. Stop engine before disconnecting or connecting battery cables.
3. Do not allow tools to cause sparks when working on a battery.
4. Do not use welder to charge batteries or jump start vehicles.
5. Observe correct polarity (+ and –) on batteries.

WARNING

STEAM AND PRESSURIZED HOT COOLANT can burn face, eyes, and skin.

The coolant in the radiator can be very hot and under pressure.

1. Do not remove radiator cap when engine is hot. Allow engine to cool.
2. Wear gloves and put a rag over cap area when removing cap.
3. Allow pressure to escape before completely removing cap.

WARNING

This product, when used for welding or cutting, produces fumes or gases which contain chemicals know to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety code Sec. 25249.5 et seq.)

NOTE

Considerations About Welding And The Effects of Low Frequency Electric and Magnetic Fields

The following is a quotation from the General Conclusions Section of the U.S. Congress, Office of Technology Assessment, Biological Effects of Power Frequency Electric & Magnetic Fields - Background Paper, OTA-BP-E-63 (Washington, DC: U.S. Government Printing Office, May 1989): "...there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex. Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks."

To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cable around the body.
4. Keep welding power source and cables as far away from body as practical.

ABOUT PACEMAKERS:

The above procedures are among those also normally recommended for pacemaker wearers. Consult your doctor for complete information.

1.02 Principal Safety Standards

Safety in Welding and Cutting, ANSI Standard Z49.1, from American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

Safety and Health Standards, OSHA 29 CFR 1910, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, American Welding Society Standard AWS F4.1, from American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices for Occupation and Educational Eye and Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, NFPA Standard 51B, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1.03 Precautions de Securite en Soudage à l'Arc

MISE EN GARDE

LE SOUDAGE A L'ARC EST DANGEREUX

PROTEGEZ-VOUS, AINSI QUE LES AUTRES, CONTRE LES BLESSURES GRAVES POSSIBLES OU LA MORT. NE LAISSEZ PAS LES ENFANTS S'APPROCHER, NI LES PORTEURS DE STIMULATEUR CARDIAQUE (A MOINS QU'ILS N'AIENT CONSULTE UN MEDECIN). CONSERVEZ CES INSTRUCTIONS. LISEZ LE MANUEL D'OPERATION OU LES INSTRUCTIONS AVANT D'INSTALLER, UTILISER OU ENTRETENIR CET EQUIPEMENT.

Les produits et procédés de soudage peuvent sauser des blessures graves ou la mort, de même que des dommages au reste du matériel et à la propriété, si l'utilisateur n'adhère pas strictement à toutes les règles de sécurité et ne prend pas les précautions nécessaires.

En soudage et coupage, des pratiques sécuritaires se sont développées suite à l'expérience passée. Ces pratiques doivent être apprises par étude ou entraînement avant d'utiliser l'equipement. Toute personne n'ayant pas suivi un entraînement intensif en soudage et coupage ne devrait pas tenter de souder. Certaines pratiques concernent les équipements raccordés aux lignes d'alimentation alors que d'autres s'adressent aux groupes électrogènes.

La norme Z49.1 de l'American National Standard, intitulée "SAFETY IN WELDING AND CUTTING" présente les pratiques sécuritaires à suivre. Ce document ainsi que d'autres guides que vous devriez connaître avant d'utiliser cet équipement sont présentés à la fin de ces instructions de sécurité.

SEULES DES PERSONNES QUALIFIEES DOIVENT FAIRE DES TRAVAUX D'INSTALLATION, DE REPARATION, D'ENTRETIEN ET D'ESSAI.

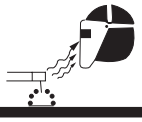
1.04 Dangers Relatifs au Soudage à l'Arc

AVERTISSEMENT

L'ELECTROCUTION PEUT ETRE MORTELLE.

Une décharge électrique peut tuer ou brûler gravement. L'électrode et le circuit de soudage sont sous tension dès la mise en circuit. Le circuit d'alimentation et les circuits internes de l'équipement sont aussi sous tension dès la mise en marche. En soudage automatique ou semi-automatique avec fil, ce dernier, le rouleau ou la bobine de fil, le logement des galets d'entrainement et toutes les pièces métalliques en contact avec le fil de soudage sont sous tension. Un équipement inadéquatement installé ou inadéquatement mis à la terre est dangereux.

1. Ne touchez pas à des pièces sous tension.
2. Portez des gants et des vêtements isolants, secs et non troués.
3 Isolez-vous de la pièce à souder et de la mise à la terre au moyen de tapis isolants ou autres.
4. Déconnectez la prise d'alimentation de l'équipement ou arrêtez le moteur avant de l'installer ou d'en faire l'entretien. Bloquez le commutateur en circuit ouvert ou enlevez les fusibles de l'alimentation afin d'éviter une mise en marche accidentelle.
5. Veuillez à installer cet équipement et à le mettre à la terre selon le manuel d'utilisation et les codes nationaux, provinciaux et locaux applicables.
6. Arrêtez tout équipement après usage. Coupez l'alimentation de l'équipement s'il est hors d'usage ou inutilisé.
7. N'utilisez que des porte-électrodes bien isolés. Ne jamais plonger les porte-électrodes dans l'eau pour les refroidir. Ne jamais les laisser traîner par terre ou sur les pièces à souder. Ne touchez pas aux porte-électrodes raccordés à deux sources de courant en même temps. Ne jamais toucher quelqu'un d'autre avec l'électrode ou le porte-électrode.
8. N'utilisez pas de câbles électriques usés, endommagés, mal épissés ou de section trop petite.
9. N'enroulez pas de câbles électriques autour de votre corps.
10. N'utilisez qu'une bonne prise de masse pour la mise à la terre de la pièce à souder.
11. Ne touchez pas à l'électrode lorsqu'en contact avec le circuit de soudage (terre).
12. N'utilisez que des équipements en bon état. Réparez ou remplacez aussitôt les pièces endommagées.
13. Dans des espaces confinés ou mouillés, n'utilisez pas de source de courant alternatif, à moins qu'il soit muni d'un réducteur de tension. Utilisez plutôt une source de courant continu.
14. Portez un harnais de sécurité si vous travaillez en hauteur.
15. Fermez solidement tous les panneaux et les capots.



AVERTISSEMENT

LE RAYONNEMENT DE L'ARC PEUT BRÛLER LES YEUX ET LA PEAU; LE BRUIT PEUT ENDOMMAGER L'OUIE.

L'arc de soudage produit une chaleur et des rayons ultraviolets intenses, susceptibles de brûler les yeux et la peau. Le bruit causé par certains procédés peut endommager l'ouïe.

1. Portez une casque de soudeur avec filtre oculaire de nuance appropriée (consultez la norme ANSI Z49 indiquée ci-après) pour vous protéger le visage et les yeux lorsque vous soudez ou que vous observez l'exécution d'une soudure.
2. Portez des lunettes de sécurité approuvées. Des écrans latéraux sont recommandés.
3. Entourez l'aire de soudage de rideaux ou de cloisons pour protéger les autres des coups d'arc ou de l'éblouissement; avertissez les observateurs de ne pas regarder l'arc.
4. Portez des vêtements en matériaux ignifuges et durables (laine et cuir) et des chaussures de sécurité.
5. Portez un casque antibruit ou des bouchons d'oreille approuvés lorsque le niveau de bruit est élevé.

AVERTISSEMENT

LES VAPEURS ET LES FUMEES SONT DANGEREUSES POUR LA SANTE.

Le soudage dégage des vapeurs et des fumées dangereuses à respirer.

1. Eloignez la tête des fumées pour éviter de les respirer.
2. A l'intérieur, assurez-vous que l'aire de soudage est bien ventilée ou que les fumées et les vapeurs sont aspirées à l'arc.
3. Si la ventilation est inadequate, portez un respirateur à adduction d'air approuvé.
4. Lisez les fiches signalétiques et les consignes du fabricant relatives aux métaux, aux produits consummables, aux revêtements et aux produits nettoyants.
5. Ne travaillez dans un espace confiné que s'il est bien ventilé; sinon, portez un respirateur à adduction d'air. Les gaz protecteurs de soudage peuvent déplacer l'oxygène de l'air et ainsi causer des malaises ou la mort. Assurez-vous que l'air est propre à la respiration.
6. Ne soudez pas à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir avec des vapeurs et former des gaz hautement toxiques et irritants.

SELECTION DES NUANCES DE FILTRES OCULAIRS POUR LA PROTECTION DES YEUX EN COUPAGE ET SOUDAGE (selon AWS á 6.2-73)

Opération de coupage ou soudage	Dimension d'électrode ou Epiasseur de métal ou Intensité de courant	Nuance de filtre oculaire	Opération de coupage ou soudage	Dimension d'électrode ou Epiasseur de métal ou Intensité de courant	Nuance de filtre oculaire
Brassage tendre au chalumeau	toutes conditions	2	Soudage á l'arc sous gaz avec fil plein (GMAW)		
Brassage fort au chalumeau	toutes conditions	3 ou 4	métaux non-ferreux	toutes conditions	11
Oxycoupage			métaux ferreux	toutes conditions	12
mince	moins de 1 po. (25 mm)	3 ou 4	Soudage á l'arc sous gaz avec électrode de tungstène (GTAW)	toutes conditions	12
moyen	de 1 á 6 po. (25 á 150 mm)	4 ou 5	Soudage á l'hydrogène atomique (AHW)	toutes conditions	12
épais	plus de 6 po. (150 mm)	5 ou 6	Soudage á l'arc avec électrode de carbone (CAW)	toutes conditions	12
Soudage aux gaz			Soudage á l'arc Plasma (PAW)	toutes dimensions	12
mince	moins de 1/8 po. (3 mm)	4 ou 5	Gougeage Air-Arc avec électrode de carbone		
moyen	de 1/8 á 1/2 po. (3 á 12 mm)	5 ou 6	mince		12
épais	plus de 1/2 po. (12 mm)	6 ou 8	épais		14
Soudage á l'arc avec électrode enrobees (SMAW)	moins de 5/32 po. (4 mm)	10	Coupage á l'arc Plasma (PAC)		
	5/32 á 1/4 po. (4 á 6.4 mm)	12	mince	moins de 300 amperès	9
	plus de 1/4 po. (6.4 mm)	14	moyen	de 300 á 400 amperès	12
			épais	plus de 400 amperès	14

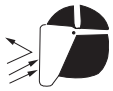
7. Ne soudez des tôles galvanisées ou plaquées au plomb ou au cadmium que si les zones à souder ont été grattées à fond, que si l'espace est bien ventilé; si nécessaire portez un respirateur à adduction d'air. Car ces revêtements et tout métal qui contient ces éléments peuvent dégager des fumées toxiques au moment du soudage.

AVERTISSEMENT

LE SOUDAGE PEUT CAUSER UN INCENDIE OU UNE EXPLOSION

L'arc produit des étincellies et des projections. Les particules volantes, le métal chaud, les projections de soudure et l'équipement surchauffé peuvent causer un incendie et des brûlures. Le contact accidentel de l'électrode ou du fil-électrode avec un objet métallique peut provoquer des étincelles, un échauffement ou un incendie.

1. Protégez-vous, ainsi que les autres, contre les étincelles et du métal chaud.
2. Ne soudez pas dans un endroit où des particules volantes ou des projections peuvent atteindre des matériaux inflammables.
3. Enlevez toutes matières inflammables dans un rayon de 10, 7 mètres autour de l'arc, ou couvrez-les soigneusement avec des bâches approuvées.
4. Méfiez-vous des projections brulantes de soudage susceptibles de pénétrer dans des aires adjacentes par de petites ouvertures ou fissures.
5. Méfiez-vous des incendies et gardez un extincteur à portée de la main.
6. N'oubliez pas qu'une soudure réalisée sur un plafond, un plancher, une cloison ou une paroi peut enflammer l'autre côté.
7. Ne soudez pas un récipient fermé, tel un réservoir ou un baril.
8. Connectez le câble de soudage le plus près possible de la zone de soudage pour empêcher le courant de suivre un long parcours inconnu, et prévenir ainsi les risques d'électrocution et d'incendie.
9. Ne dégelez pas les tuyaux avec un source de courant.
10. Otez l'électrode du porte-électrode ou coupez le fil au tube-contact lorsqu'inutilisé après le soudage.
11. Portez des vêtements protecteurs non huileux, tels des gants en cuir, une chemise épaisse, un pantalon revers, des bottines de sécurité et un casque.



AVERTISSEMENT

LES ETINCELLES ET LES PROJECTIONS BRULANTES PEUVENT CAUSER DES BLESSURES.

Le piquage et le meulage produisent des particules métalliques volantes. En refroidissant, la soudure peut projeter du éclats de laitier.

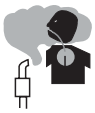
1. Portez un écran facial ou des lunettes protectrices approuvées. Des écrans latéraux sont recommandés.
2. Portez des vêtements appropriés pour protéger la peau.

AVERTISSEMENT

LES BOUTEILLES ENDOMMAGEES PEUVENT EXPLOSER

Les bouteilles contiennent des gaz protecteurs sous haute pression. Des bouteilles endommagées peuvent exploser. Comme les bouteilles font normalement partie du procédé de soudage, traitez-les avec soin.

1. Protégez les bouteilles de gaz comprimé contre les sources de chaleur intense, les chocs et les arcs de soudage.
2. Enchainez verticalement les bouteilles à un support ou à un cadre fixe pour les empêcher de tomber ou d'être renversées.
3. Eloignez les bouteilles de tout circuit électrique ou de tout soudage.
4. Empêchez tout contact entre une bouteille et une électrode de soudage.
5. N'utilisez que des bouteilles de gaz protecteur, des détendeurs, des boyauxs et des raccords conçus pour chaque application spécifique; ces équipements et les pièces connexes doivent être maintenus en bon état.
6. Ne placez pas le visage face à l'ouverture du robinet de la bouteille lors de son ouverture.
7. Laissez en place le chapeau de bouteille sauf si en utilisation ou lorsque raccordé pour utilisation.
8. Lisez et respectez les consignes relatives aux bouteilles de gaz comprimé et aux équipements connexes, ainsi que la publication P-1 de la CGA, identifiée dans la liste de documents ci-dessous.



AVERTISSEMENT

LES MOTEURS PEUVENT ETRE DANGEREUX

LES GAZ D'ECHAPPEMENT DES MOTEURS PEUVENT ETRE MORTELS.

Les moteurs produisent des gaz d'échappement nocifs.

1. Utilisez l'équipement à l'extérieur dans des aires ouvertes et bien ventilées.
2. Si vous utilisez ces équipements dans un endroit confiné, les fumées d'échappement doivent être envoyées à l'extérieur, loin des prises d'air du bâtiment.

AVERTISSEMENT

LE CARBURANT PEUR CAUSER UN INCENDIE OU UNE EXPLOSION.

Le carburant est hautement inflammable.

1. Arrêtez le moteur avant de vérifier le niveau e carburant ou de faire le plein.
2. Ne faites pas le plein en fumant ou proche d'une source d'étincelles ou d'une flamme nue.
3. Si c'est possible, laissez le moteur refroidir avant de faire le plein de carburant ou d'en vérifier le niveau au début du soudage.
4. Ne faites pas le plein de carburant à ras bord: prévoyez de l'espace pour son expansion.
5. Faites attention de ne pas renverser de carburant. Nettoyez tout carburant renversé avant de faire démarrer le moteur.

AVERTISSEMENT

DES PIECES EN MOUVEMENT PEUVENT CAUSER DES BLESSURES.

Des pièces en mouvement, tels des ventilateurs, des rotors et des courroies peuvent couper doigts et mains, ou accrocher des vêtements amples.

1. Assurez-vous que les portes, les panneaux, les capots et les protecteurs soient bien fermés.
2. Avant d'installer ou de connecter un système, arrêtez le moteur.
3. Seules des personnes qualifiées doivent démonter des protecteurs ou des capots pour faire l'entretien ou le dépannage nécessaire.
4. Pour empêcher un démarrage accidentel pendant l'entretien, débranchez le câble d'accumulateur à la borne négative.
5. N'approchez pas les mains ou les cheveux de pièces en mouvement; elles peuvent aussi accrocher des vêtements amples et des outils.
6. Réinstallez les capots ou les protecteurs et fermez les portes après des travaux d'entretien et avant de faire démarrer le moteur.

AVERTISSEMENT

DES ETINCELLES PEUVENT FAIRE EXPLOSER UN ACCUMULATEUR; L'ELECTROLYTE D'UN ACCUMULATEUR PEUT BRULER LA PEAU ET LES YEUX.

Les accumulateurs contiennent de l'électrolyte acide et dégagent des vapeurs explosives.

1. Portez toujours un écran facial en travaillant sur un accumu-lateur.
2. Arrêtez le moteur avant de connecter ou de déconnecter des câbles d'accumulateur.
3. N'utilisez que des outils anti-étincelles pour travailler sur un accumulateur.
4. N'utilisez pas une source de courant de soudage pour charger un accumulateur ou survolter momentanément un véhicule.
5. Utilisez la polarité correcte (+ et –) de l'accumulateur.

AVERTISSEMENT

LA VAPEUR ET LE LIQUIDE DE REFROIDISSEMENT BRULANT SOUS PRESSION PEUVENT BRULER LA PEAU ET LES YEUX.

Le liquide de refroidissement d'un radiateur peut être brûlant et sous pression.

1. N'ôtez pas le bouchon de radiateur tant que le moteur n'est pas refroidi.
2. Mettez des gants et posez un torchon sur le bouchon pour l'ôter.
3. Laissez la pression s'échapper avant d'ôter complètement le bouchon.

1.05 Principales Normes De Securite

Safety in Welding and Cutting, norme ANSI Z49.1, American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33128.

Safety and Health Standards, OSHA 29 CFR 1910, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, norme AWS F4.1, American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33128.

National Electrical Code, norme 70 NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

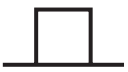
Safe Handling of Compressed Gases in Cylinders, document P-1, Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, norme CSA W117.2 Association canadienne de normalisation, Standards Sales, 276 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices for Occupation and Educational Eye and Face Protection, norme ANSI Z87.1, American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, norme 51B NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

SYMBOL LEGEND

A	Amperage
V	Voltage
Hz	Hertz (frequency)
SEC	Seconds
%	Percent
⎓	DC (Direct Current)
~	AC (Alternating Current)
	Standard Function
	Slope Function
	Slope W/Repeat Function
	Spot Function
	Impulse Starting (High Frequency GTAW)
	Touch Start (Lift Start TIG circuit GTAW)

	STICK (Shielded Metal Arc SMAW)
	Pulse Current Function
	Spot Time (GTAW)
	Remote Control (Panel/Remote)
	Remote Function
	Arc Control (SMAW)
	Gas Post-Flow
	Gas Pre-Flow
VRD	Voltage Reduction Device Circuit
—	Negative
+	Positive
	Gas Input
	Gas Output

2 INTRODUCTION AND DESCRIPTION

1 Description

The Thermal Arc™ 400MST is a single & three-phase DC arc welding power source with Constant Current (CC) and Constant Voltage (CV) output characteristics. This unit is equipped with a Digital Volt/Amperage, lift arc starter for use with Gas Tungsten Arc Welding (GTAW), Arc Control and Hot Start for Shielded Metal Arc Welding (SMAW), Inductance Control for Gas Metal Arc Welding (GMAW) processes. The power source is totally enclosed in an impact resistant, flame resistant and non-conductive plastic case.

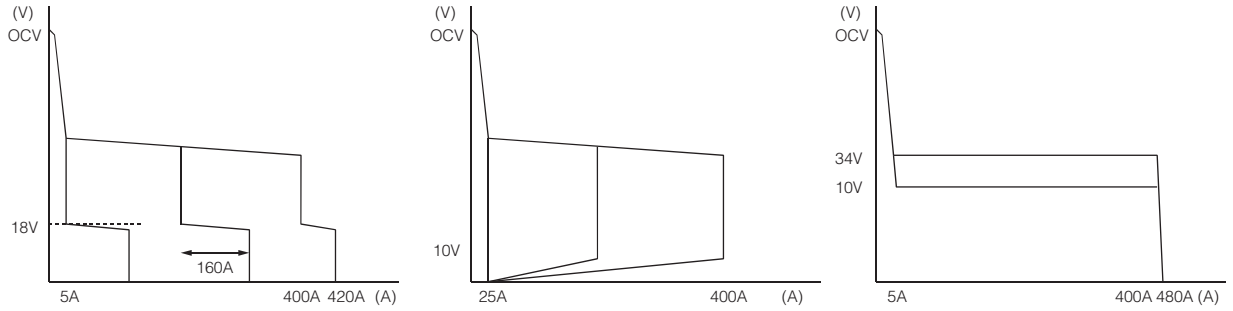


Figure 2-1: Model 400MST volt-ampere curve

NOTE

Volt-Ampere curves show the maximum Voltage and Amperage output capabilities of the welding power source. Curves of other settings will fall between the curves shown.

2 Functional Block Diagrams

Figure 2-2 illustrates the functional block diagram of the 400MST-power supply.

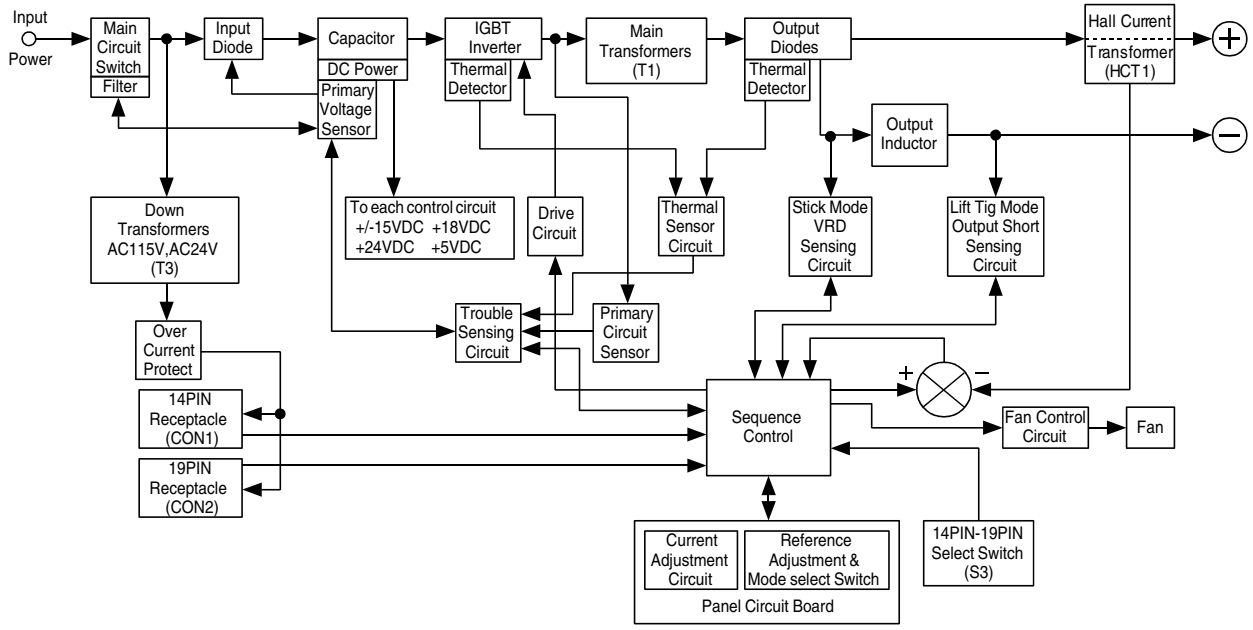


Figure 2-2: 400MST Model functional block diagram

3 Transporting Methods

These units are equipped with a handle for carrying purposes.

WARNING

ELECTRIC SHOCK can kill. DO NOT TOUCH live electrical parts. Disconnect input power conductors from de-energized supply line before moving the welding power source.

WARNING

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

Lift unit with handle on top of case.

Use handcart or similar device of adequate capacity.

If using a fork lift vehicle, place and secure unit on a proper skid before transporting.

4 Installation Recommendations

4.1 Environment

The 400MST is designed for use in hazardous environments.

Examples of environments with increased hazardous environments are -

a. In locations in which freedom of movement is restricted, so that the operator is forced to perform the work in a cramped (kneeling, sitting or lying) position with physical contact with conductive parts;

b. In locations which are fully or partially limited by conductive elements, and in which there is a high risk of unavoidable or accidental contact by the operator, or

c. In wet or damp hot locations where humidity or perspiration considerably reduces the skin resistance of the human body and the insulation properties of accessories.

Environments with hazardous environments do not include places where electrically conductive parts in the near vicinity of the operator, which can cause increased hazard, have been insulated.

4.2 Location

Be sure to locate the welder according to the following guidelines:

- In areas, free from moisture and dust.
- Ambient temperature between 0 degrees C to 40 degrees C.
- In areas, free from oil, steam and corrosive gases.
- In areas, not subjected to abnormal vibration or shock.
- In areas, not exposed to direct sunlight or rain.
- Place at a distance of 12" (304.79mm) or more from walls or similar that could restrict natural airflow for cooling.

WARNING

Thermal Arc advises that this equipment be electrically connected by a qualified electrician.

5 Electrical Input Connections

WARNING

ELECTRIC SHOCK can kill; SIGNIFICANT DC VOLTAGE is present after removal of input power.

DO NOT TOUCH live electrical parts.

SHUT DOWN welding power source, disconnect input power employing lockout/tagging procedures. Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

5.1 Electrical Input Requirements

Operate the welding power source from a single or three-phase 50/60 Hz, AC power supply. The input voltage must match one of the electrical input voltages shown on the input data label on the unit nameplate. Contact the local electric utility for information about the type of electrical service available, how proper connections should be made, and inspection required.

The line disconnect switch provides a safe and convenient means to completely remove all electrical power from the welding power supply whenever necessary to inspect or service the unit.

NOTE

These units are equipped with a three-conductor with earth power cable that is connected at the welding power source end for single or three-phase electrical input power.

Do not connect an input (WHITE, BLACK or RED) conductor to the ground terminal.

Do not connect the ground (GREEN) conductor to an input line terminal.

Refer to Figure 2-3 and:

1. Connect end of ground (GREEN) conductor to a suitable ground. Use a grounding method that complies with all applicable electrical codes.
2. Connect ends of line 1 (BLACK) and line 2 (WHITE) and line 3 (RED) input conductors to a de-energized line disconnect switch.
3. Use Table 1 and Table 2 as a guide to select line fuses for the disconnect switch.

NOTE

For Single-Phase operation connect the GREEN, BLACK and WHITE input conductors. Insulate the RED Conductor, it is not used for Single-phase operation.

Input Voltage	Fuse Size
208 VAC	100 Amps
230 VAC	75 Amps
460 VAC	50 Amps

Table 2-1: Electrical Input Connections

NOTE

Fuse size is based on not more than 200 percent of the rated input amperage of the welding power source (Based on Article 630, National Electrical Code).

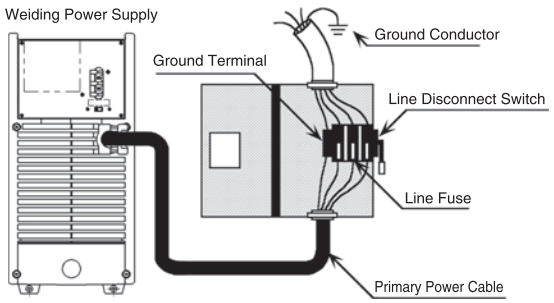


Figure 2-3: Electrical input connections

5.2 Input Power

Each unit incorporates an INRUSH circuit and input voltage sensing circuit. When the MAIN SWITCH is turned on, the inrush circuit provides a pre-charging of the input capacitors. At this point, the Bus Voltages are checked and the welder is enabled after the input capacitors have charged to full operating voltage (after approximately 5 seconds).

NOTE

Note the available input power. Damage to the welder could occur if 575VAC or higher is applied.

The following 208-230/460V Primary Current recommendations are required to obtain the maximum welding current and duty cycle from this welding equipment:

Model	Primary Supply Lead Size	Minimum Primary Current Circuit Size (Vin/Amps)		Current & Duty Cycle		
				MIG	TIG	STICK
400MST	8/4 AWG minimum (Factory Fitted)	3ϕ	208/63	400A@ 25%	-	-
			230/57		-	-
			460/29		-	-
			208/49	-	400A@ 25%	-
			230/44	-		-
			460/22	-		-
			208/67	-	-	400A@ 25%
			230/61	-	-	
			460/31	-	-	
	8/3 AWG minimum	1ϕ	208/88	300A@ 25%	-	-
			230/79		-	-
			208/67	-	300A@ 25%	-
			230/60	-		-
			208/97	-	-	300A@ 25%
			230/87	-	-	

Table 2-2: Primary Current Circuit sizes to achieve maximum current

6 Specifications

Parameter		400MST	
Rated Output			
Amperes		400	
Volts		36	
Duty Cycle		25%	
Duty Cycle	TIG	400A / 26V@25%	
		300A / 22V@60%	
		200A / 18V@100%	
	STICK	400A / 36V@25%	
		300A / 32V@60%	
		200A / 28V@100%	
	MIG	400A / 34V@25%	
		300A / 29V@60%	
		200A / 24V@100%	
Output Current Range	TIG STICK	5-400A	
Output Voltage Range	MIG	5-36V	
Open Circuit Voltage		65V	
Dimensions			
Width		8.27" (210mm)	
Height		16.89" (420mm)	
Length		17.72" (450mm)	
Weight		55.1 lb. 25.0 kg	
Output@Rated Load		Three-phase	Single-phase
Rated Input Voltage		208-230/460V	208-230V
Output Amperes		400A	300A
Output Volts		36V	32V
Duty Cycle		25%	25%
KVA		24.0	20.0
KW		18.0	12.0
Output@No Load			
KVA		0.5	
KW		0.13	
Input Volts Single Phase		Amperage Draw @Rated Load	No Load
208V		97	2.4
230V		87	2.2
Input Volts Three Phase			
208V		67	1.4
230V		61	1.3
460V		31	0.7

Thermal Arc continuously strives to produce the best product possible and therefore reserves the right to change, improve or revise the specifications or design of this or any product without prior notice. Such updates or changes do not entitle the buyer of equipment previously sold or shipped to the corresponding changes, updates, improvements or replacement of such items.

7 Duty Cycle

The duty cycle of a welding power source is the percentage of a ten (10) minute period that it can be operated at a given output without causing overheating and damage to the unit. If the welding amperes decrease, the duty cycle increases. If the welding amperes are increased beyond the rated output, the duty cycle will decrease.

⚠ WARNING

Exceeding the duty cycle ratings will cause the thermal overload protection circuit to become energized and shut down the output until the unit has cooled to normal operating temperature.

CAUTION

Continually exceeding the duty cycle ratings can cause damage to the welding power source and will void the manufactures warranty.

NOTE

Due to variations that can occur in manufactured products, claimed performance, voltages, ratings, all capacities, measurements, dimensions and weights quoted are approximate only. Achievable capacities and ratings in use and operation will depend upon correct installation, use, applications, maintenance and service.

3 OPERATOR CONTROLS

1 400MST Controls

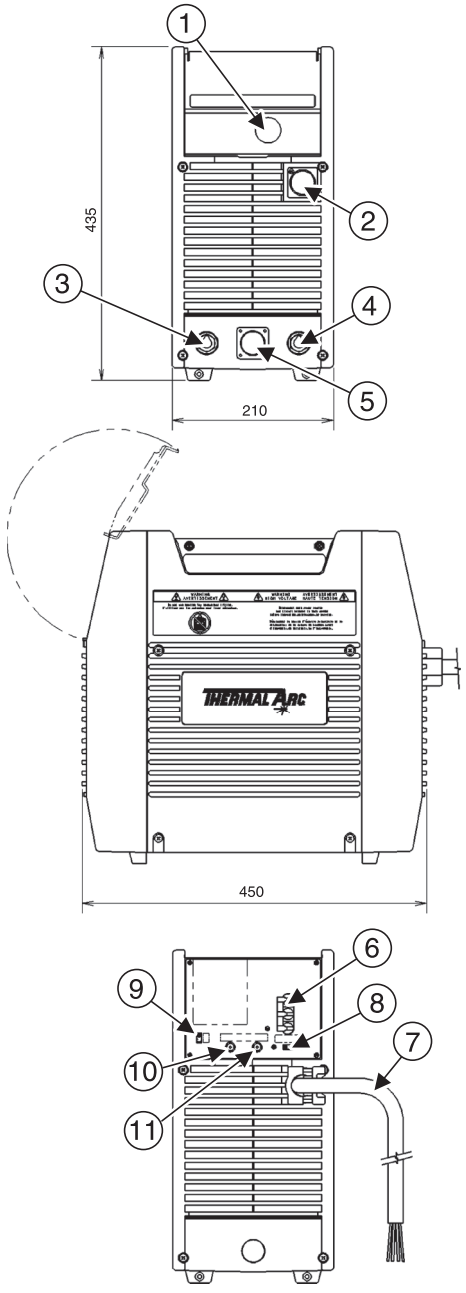


Figure 3-1: 400MST Power Source

1. Control Knob
   This control sets the selected weld parameter, rotating it clockwise increases the parameter and is indicated on the digital meter. Pushing the knob in previews the actual welding voltage while welding.
2. Remote Control Socket
   The 14 pin Remote Control Socket is used to connect remote current control devices to the welding Power Source. To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.

Socket Pin	Function
A	24VAC auxiliary high side.
B	Input to energize solid state contactor (Contact closure between pin A and pin B).
C	5k ohm (maximum) connection to 5k ohm remote control potentiometer.
D	Zero ohm (minimum) connection to 5k ohm remote control potentiometer.
E	Wiper arm connection to 5k ohm remote control potentiometer.
F	Current feedback Ifb = 100Amps/Volt
G	24/115 VAC circuit common, also connected to chassis.
H	Voltage Feedback Vfb = 10 Arc Volts/Volt
I	115 VAC auxiliary high side.
J	115 VAC input to energize solid state contactor (Contact closure between pin I and pin J).
K	Chassis ground.
L	Not used.
M	Current Detect.
N	Current Detect.

3. Positive Terminal
   Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.
4. Negative Terminal
   Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

CAUTION

Loose welding terminal connections can cause overheating and result in the male plug being fused in the bayonet terminal and /or melting of the housing (case).

5. Remote Control Socket
   The 19 pin Remote Control Socket is used to connect remote current control devices to the welding Power Source. To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.

Socket Pin	Function
A	Contactor circuit (+15 Volts).
B	Contactor circuit in, (closure between pin A and Pin B will energize output.).
C	Scaled output voltage signal: Vfb = 10 Arc Volts/ Volt
D	24 VAC auxiliary power high side.
E	115 VAC auxiliary power high side.
G	Chassis ground.
H	Remote control maximum.
J	Remote control wiper (0 - 10 Volts).
K	Remote Control minimum.
J	Remote control wiper (0 - 10 Volts).
L	Control circuit common.
M	Arc Establish = +12 Volts
N	Control Circuit common.
P	24 VAC auxiliary power high side.
R	24/115 VAC neutral
S	N/C
T	N/C
U	Scaled output signal: Ifb = 100 Amps/Volt
V	N/C

6. ON/OFF Switch
   This switch connects the Primary supply voltage to the inverter when in the ON position. This enables the Power Supply.

WARNING

When the welder is connected to the Primary supply voltage, the internal electrical components may be at 720V potential with respect to earth.

7. Input Cable
   The input cable connects the Primary supply voltage to the equipment.
8. Voltage Input Select Switch (Smart Logic Switch)
   User selectable switch.
   A manual slide switch selects the proper input voltage range. If this slide switch is not set to the position that matches the input line voltage, the Smart Logic will inhibit the welding power source from turning on and a warning indication will be displayed.

WARNING

Do not alter the position of the Voltage Input Select Switch when the ON/OFF Switch is in the ON position and the unit is powered up.

9. 14/19 Pin Remote Control Select Switch
   User selectable switch.
   Position this switch for the remote control device socket to be utilized. The unselected Remote Control Socket is disabled at this time and cannot be utilized. Do not alter the position of this switch while one of the Remote Control Sockets is being utilized.
10. 24VAC Remote Device C/B
    Push to reset. Controls the 24VAC power source for the wire feeders controlled through the Remote Control Sockets.
11. 115VAC Remote Device C/B
    Push to reset. Controls the 115VAC power source for the wire feeders controlled through the Remote Control Sockets.

2 Weld Parameter Descriptions for 400MST

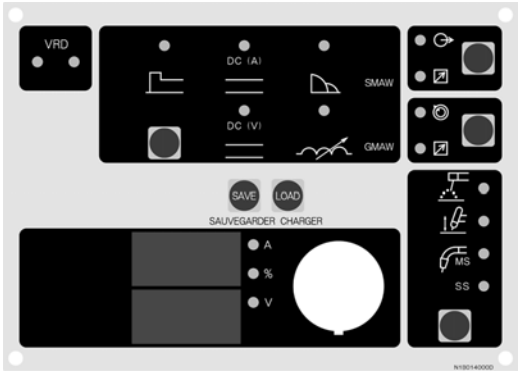


Figure 3-2: 400MST Front Panel with Parameter Description

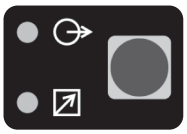
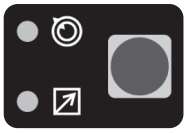
Parameter	Description
 ARC CONTROL	This parameter provides a suitable short circuit current in STICK welding to improve electrode sticking and arc stability.
 HOT START	This parameter operates in STICK weld mode and is used to improve the start characteristics for stick electrodes. e.g. low hydrogen electrodes. It sets the peak start current on top of the (WELD) current.
DC (A)	Weld Current (Amperage)- when lit parameter knob sets the STICK and TIG WELD current.
DC (V)	Weld Voltage (Volt) - when lit parameter knob sets the MIG voltage.
 Contactor ON/OFF	Contactor operation in Stick Mode.
 Operation PANEL / REMOTE	Selects mode of operation: Panel or Remote.
 INDUCTANCE	This parameter, similar to the ARC CONTROL in STICK mode, allows for the adjustment of the dynamic property of the arc. As the inductance is increased the output voltage may need to be adjusted to achieve the desired weld characteristics.
 SAUVEGARDER CHARGER	The SAVE/LOAD buttons are used to save and retrieve a total number of 5 programs into the 400MST memory.

Table 3-1: Weld Parameter Descriptions for 400MST

3 Weld Process selection for the 400MST

	Weld Mode			
Weld Parameter	STICK	MIG	LIFT TIG	Description
WELD (V)	×	✓	×	Weld voltage MIG Mode.
INDUCT-ANCE	×	✓	×	Inductance control in MIG Mode.
HOT START	✓	×	×	Start current in amps is added to the WELD (A).
WELD (A)	✓	×	✓	WELD (A) current for STICK or LIFT TIG.
ARC CONTROL	✓	×	×	Adjusts percentage increase in welding current and is proportional to arc length (arc voltage).

Table 3-2: Weld Process selection verses Weld Mode

4 Weld Parameter Descriptions

4.1 WELD (V)

This parameter sets the MIG weld arc voltage in MIG mode.

4.2 INDUCTANCE

This parameter sets the INDUCTANCE when MIG welding. It controls the dynamic properties of the arc in dip transfer welding mode. When this parameter is set to 0%, ie minimum inductance, the arc has a fast response with a resulting crisp arc noise and coarse spatter. When this parameter is set to 100%, ie maximum inductance, the arc has a slow response with a resulting soft arc and fine spatter.

NOTE

As the INDUCTANCE is increased, the WELD (V) may need to be adjusted to achieve the desired weld characteristic.

4.3 HOT START

This parameter operates in STICK mode and improves the start characteristics for stick electrodes. e.g. low hydrogen electrodes. It sets the peak start current on top of the WELD current.

e.g. HOT START current = 150 amps when Weld Current = 100 amps & HOT START = 50A

4.4 WELD (A)

This parameter sets the STICK & Lift TIG weld current.

4.5 ARC CONTROL

This parameter operates in STICK mode only and is used to adjust percentage increase in welding current and is proportional to arc length (arc voltage). This control provides an adjustable amount of arc control (or dig). This feature can be particularly beneficial in providing the operator with the ability to compensate for variability in joint fit up in certain situations with particular electrodes, eg cellulose and hydrogen controlled electrodes. In all welding processes, the amount of penetration obtained is dependent on the welding current; ie the greater the penetration, the greater the current.

Arc Force Position	Current Increase when Arc Voltage is less than 18V	Effect on Welding Performance
Minimum (0)	0A	Soft arc, Low spatter, Low penetration
Medium (20%)	32A	Normal arc, Improved fusion characteristics, Normal penetration
Maximum (100%)	160A	Hard arc, Deep penetration

Table 3-3: Weld Parameter Descriptions

In general, having the ARC CONTROL set at 100% (maximum) allows greater penetration control to be achieved. With the ARC CONTROL set at 0% (minimum) the Power Source has a constant current characteristic. In other words, varying the arc length does not significantly effect the welding current. When the ARC CONTROL set to 100%, it is possible to control the welding current by varying the arc length. This is very useful for controlling penetration on root runs and side wall wash on vertical up fillet welds.

i) Root runs

During root runs the weld pool forms a "keyhole" shape. If too much weld current is used, the hole blows out and the weld collapses. If too little weld current is used, the hole closes up and penetration is lost. The size of the hole also determines the arc length; ie as the hole gets bigger, the arc gets longer.

If arc force is used, the increase in the arc length causes the weld current to decrease until the hole starts to close up but if the hole closes up to much then the arc length decreases which causes the weld current to increase. Too little or too much arc force makes this process unstable. The operator must adjust the arc force until a happy medium is reached.

ii) Vertical up welding

When welding vertical up with arc force on, the operator can control the amount of current by changing arc length, ie voltage. Weld metal is deposited by "digging" the electrode into the side of the base metal joint and then increasing the arc length with a flicking motion, to allow the weld pool to freeze, before digging the electrode into the other side of the base metal joint.

Without arc force, increasing the arc length does not decrease the weld current sufficiently and the operator has to manually decrease the current via a remote current control to freeze the weld pool. This welding current reduction also reduces the penetration.

The arc force allows the weld pool to freeze during the "flick" phase without decreasing the amount of weld current available during the "dig" phase thus maximizing penetration.

4.6 Weld Parameters

Weld Parameter	Parameter Range	Factory Setting	Units of Increment	Weld Mode		
				STICK	MIG	LIFT TIG
WELD (V) MIG	10.0 to 36.0V DC	17.0V	0.1V	×	✓	×
INDUCT-ANCE	0 to 100%	10%	1%	×	✓	×
HOT START	0 to 70A	20A	1A	✓	×	×
WELD (A) TIG or STICK	1 to 400A DC	80A	1A	✓	×	✓
ARC CONTROL	0 to 100%	10%	1%	✓	×	×

Table 3-4: Weld Parameters

4.7 Power Source Features

Feature	Description
New Digital Control	• All welding parameters are adjustable.
Touch Panel Switches	• Touch switches eliminate mechanical damage.
Front Control Cover	• Protects front panel controls.
Digital Meter Volt & Ammeter	• Displays selected weld parameter value. • Displays average weld current when welding. • Displays average weld current for 20 seconds after weld has been completed. • A selected weld parameter value can be adjusted at any time even while welding.
Intelligent Fan Control	• The intelligent cooling system is designed to reduce dust and foreign material build-up, while providing optimum cooling. • Fan speed reduces approximately 30 seconds after machine is turned on. • Fan speed increases when internal components reach operating temperature.
ON/OFF switch	• Mains ON/OFF switch located on rear panel.
Voltage Reduction Device (VRD)	• VRD fully complies to IEC 60974-1. • VRD light is ON and operational when in STICK mode.
Control Knob	• For the selected weld parameter, rotating the knob clockwise increases the parameter. • Rotating the knob counter clockwise decreases the parameter. • A selected weld parameter value can be adjusted at any time even while welding. • Pushing the knob in sets the selected parameter then displays the next parameter.
Self Diagnosis Using Error Codes	• An error code is displayed on the Digital Meter when a problem occurs with Mains supply voltage or internal component problems.
Save/Load function	• A total number of 5 programs can be saved into the 400MST memory. **SAVE the Current Weld Parameters into Memory** • Press the SAVE button. • Select a memory location by rotating the control knob, 1 to 5 is displayed on the meter. • After selecting the desired memory location (ie. 1 to 5), press the parameter button and the machine give a beep to confirm the weld parameters from the control panel are saved. **LOAD (retrieve) a Program to Control Panel** • Press the LOAD button. • Select a memory location by rotating the control knob, 1 to 5 is displayed on the meter. After selecting the desired memory location (ie. 1 to 5), press the parameter button and the machine give a beep to confirm the weld parameters are loaded onto the control panel.

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4 SEQUENCE OF OPERATION

NOTE: Parameter Buttons are used to select the parameters to be set. The LED's show which function is being adjusted on the weld sequence graph. Refer to Symbols Table located in the front of the manual for Symbol descriptions.

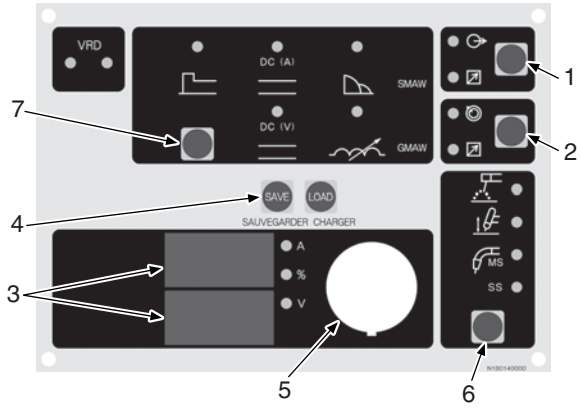


Figure 4-1: 400MST Front Panel

1. Contactor function - Pressing this button enables Contactor functions.
2. Remote functions - Pressing this button enables remote current functions.
3. Digital LED displays - Welding amperage, Voltage and parameter values are displayed in this window. Internal warnings such as over temperature, low or high input voltage applied are signaled to the operator by a warning sound and error message on the screen.
4. Save/Load Buttons -By using the Save & Load buttons the operator can easily save up to 5 welding parameter programs.
5. Control knob - Allows the operator to adjust the output amperage/voltage within the entire range of the power source, also used to set each parameter value.
6. Process Button - This button selects between STICK, Lift TIG, and MIG modes. MIG modes include MS for mild steel and SS for stainless steel.
7. Parameter Button. - This button selects between HOT START, WELD CURRENT, and ARC CONTROL while in STICK and Lift TIG modes and selects between WELD VOLTAGE and INDUCTANCE CONTROL while in MIG mode. This button is also used in conjunction with the Save/Load buttons to save and load welding programs.

1 Stick Welding

- Connect work lead to negative terminal.
- Connect electrode lead to positive terminal.
- Switch machine on.
- Set weld current.
- Set Contactor.
- Connect remote control device if required.

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

- Set HOT START .
- Set ARC CONTROL.
- Set WELD current .

Commence welding.

2 LIFT TIG Welding

- Connect work lead to positive terminal.
- Connect TIG torch to negative terminal.
- Switch machine on.
- Set weld current.
- Connect remote control device if required.

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

Commence welding.

3 MIG Welding

- Connect work lead to negative terminal.
- Connect electrode lead to positive terminal.
- Switch machine on.
- Set weld voltage.
- Set Inductance.
- Connect Wire feeder.
- Set wire feed speed (IPM).

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

Commence welding.

5 ROUTINE MAINTENANCE

The only routine maintenance required for the power supply is a thorough cleaning and inspection, with the frequency depending on the usage and the operating environment.

WARNING

Disconnect primary power at the source before opening the enclosure. Wait at least two minutes before opening the enclosure to allow the primary capacitors to discharge.

To clean the unit, open the enclosure (refer to 'Opening the Enclosure' section 9.1.1) and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean, if necessary; with solvents that are recommended for cleaning electrical apparatus.

CAUTION

Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.

6 BASIC TROUBLE SHOOTING

⚠ WARNING

There are extremely dangerous voltages and power levels present inside this product. Do not attempt to open or repair unless you are an Accredited Thermal Arc Service Agent and you have had training in power measurements and troubleshooting techniques.

If major complex subassemblies are faulty, then the Welding Power Source must be returned to an Accredited Thermal Arc Service Agent for repair.

The basic level of troubleshooting is that which can be performed without special equipment or knowledge.

1 Solving MIG Problems Beyond the Welding Terminals

The general approach to fix Gas Metal Arc Welding (GMAW) problems is to start at the wire spool then work through to the MIG torch. There are two main areas where problems occur with GMAW:

1.1 Porosity

When there is a gas problem the result is usually porosity within the weld metal. Porosity always stems from some contaminant within the molten weld pool which is in the process of escaping during solidification of the molten metal.

Contaminants range from no gas around the welding arc to dirt on the work piece surface. Porosity can be reduced by checking the following points:

1. Gas cylinder contents and flow meter.

   Ensure that the gas cylinder is not empty and the flow meter is correctly adjusted to 25 cubic feet per hour.

2. Gas leaks.

   Check for gas leaks between the regulator/ cylinder connection and in the gas hose to the Wire Feeder. Internal gas hose in the Wire Feeder.

3. Internal gas hose in the Wire Feeder.

   Ensure the hose from the solenoid valve to the MIG torch adapter has not fractured and that it is connected to the MIG torch adapter.

4. Welding in a windy environment.

   Shield the weld area from the wind or increase the gas flow.

5. Welding dirty, oily, painted, oxidized or greasy plate.

   Clean contaminates off the plate.

6. Distance between the MIG torch nozzle and the work piece.

   Keep the distance between the MIG torch nozzle and the work piece to a minimum.

7. Maintain the MIG torch in good working order.

   Ensure that the gas holes are not blocked and gas is exiting out of the torch nozzle.
   Do not restrict gas flow by allowing spatter to build up inside the MIG torch nozzle.
   Check that the MIG torch O-rings are not damaged.

⚠ WARNING

Disengage the drive roll when testing for gas flow by ear.

1.2 Inconsistent Wire Feed

Checking the following points can reduce wire-feeding problems:

1. Wire spool brake is too tight.

   Feed roller driven by motor in the cabinet will slip.

2. Wire spool brake is too loose.

   Wire spool can unwind and tangle.

3. Worn or incorrect feed roller size.

   Use 'U' groove drive feed roller matched to the aluminium wire size you are welding.

   Use 'V' groove drive feed roller matched to the steel wire size you are welding.

   Use 'knurled V' groove drive feed roller matched to the flux cored wire size you are welding.

4. Misalignment of inlet/outlet guides.

   Wire will rub against the misaligned guides and reduce wire feedability.

5. Liner blocked with wire debris.

   Wire debris is produced by the wire passing through the feed roller, if excessive pressure is applied to the pressure roller adjuster.

   Wire debris can also be produced by the wire passing through an incorrect feed roller groove shape or size.

Wire debris is fed into the liner where it accumulates thus reducing wire feedability.

6. Incorrect or worn contact tip.

The contact tip transfers the weld current to the electrode wire. If the hole in the contact tip is to large then arcing may occur inside the contact tip resulting in the electrode wire jamming in the contact tip.

When using soft electrode wire such as aluminium it may become jammed in the contact tip due to expansion of the wire when heated. A contact tip designed for soft electrode wires should be used.

7. Poor work lead contact to work piece.

If the work lead has a poor electrical contact to the work piece then the connection point will heat up and result in a reduction of power at the arc.

8. Bent liner.

This will cause friction between the wire and the liner thus reducing wire feedability.

2 MIG Welding Problems

Description	Possible Cause	Remedy
1 Undercut.	A Welding arc voltage too high. B Incorrect torch angle. C Excessive heat input.	A Reduce WELD (V) control or increase the wire feed speed. B Adjust angle. C Increase the torch travel speed and/or reduce welding current by reducing the WELD (V) control or reducing the wire feed speed.
2 Lack of penetration.	A Welding current too low. B Joint preparation too narrow or gap too tight. C Shielding gas incorrect.	A Increase welding current by increasing wire feed speed and increasing WELD (V) control. B Increase joint angle or gap. C Change to a gas which gives higher penetration.
3 Lack of fusion.	Voltage too low.	Increase WELD (V) control.
4 Excessive spatter.	A Voltage too high. B Voltage too low.	A Lower the voltage by reducing the WELD (V) control or increase wirespeed control. B Raise the voltage by increasing the WELD (V) control or reduce wirespeed control.
5 Irregular weld shape.	A Incorrect voltage and current settings. Convex, voltage too low. Concave, voltage too high. B Wire is wandering. C Incorrect shielding gas. D Insufficient or excessive heat input.	A Adjust voltage and current by adjusting the WELD (V) control and the wirespeed control. B Replace contact tip. C Check shielding gas. D Adjust the wirespeed control or the voltage selection switches.
6 Weld cracking.	A Weld beads too small. B Weld penetration narrow and deep. C Excessive weld stresses. D Excessive voltage. E Cooling rate too fast.	A Decrease travel speed. B Reduce current and voltage and increase MIG torch travel speed or select a lower penetration shielding gas. C Increase weld metal strength or revise design. D Decrease voltage by reducing the WELD (V) control. E Slow the cooling rate by preheating part to be welded or cool slowly.

Description	Possible Cause	Remedy
7 Cold weld puddle.	A Faulty rectifier unit. B Loose welding cable connection. C Low Primary Voltage.	A Have an Accredited Thermal Arc Service Agent to test then replace the faulty component. B Check all welding cable connections. C Contact supply authority.
8 Arc does not have a crisp sound, that short arc exhibits, when the wirefeed speed and voltage are adjusted correctly.	The MIG torch has been connected to the wrong voltage polarity on the front panel.	Connect the MIG torch to the positive (+) welding terminal for solid wires and gas shielded flux cored wires. Refer to the electrode wire manufacturer for the correct polarity.

3 TIG Welding Problems

Weld quality is dependent on the selection of the correct consumables, maintenance of equipment and proper welding technique.

Description	Possible Cause	Remedy
1 Excessive beard build-up or poor penetration or poor fusion at edges of weld.	Welding current is too low.	Increase weld current and/or faulty joint preparation.
2 Weld bead too wide and flat or undercut at edges of weld or excessive burn through.	Welding current is too high.	Decrease weld current.
3 Weld bead too small or insufficient penetration or ripples in bead are widely spaced apart.	Travel speed too fast.	Reduce travel speed.
4 Weld bead too wide or excessive bead build up or excessive penetration in butt joint.	Travel speed too slow.	Increase travel speed.
5 Uneven leg length in fillet joint.	Wrong placement of filler rod.	Re-position filler rod.
6 Electrode melts when arc is struck.	A Electrode is connected to the '+' terminal.	A Connect the electrode to the '-' terminal.
7 Dirty weld pool.	A Electrode contaminated through contact with work piece or filler rod material. B Gas contaminated with air.	A Clean the electrode by grinding off the contaminates. B Check gas lines for cuts and loose fitting or change gas cylinder.
8 Electrode melts or oxidizes when an arc is struck.	A No gas flowing to welding region. B Torch is clogged with dust. C Gas hose is cut. D Gas passage contains impurities. E Gas regulator turned off. F Torch valve is turned off. G The electrode is too small for the welding current.	A Check the gas lines for kinks or breaks and gas cylinder contents. B Clean torch. Replace gas hose. D Disconnect gas hose from torch then raise gas pressure and blow out impurities. E Turn on. F Turn on. G Increase electrode diameter or reduce the welding current.

Description	Possible Cause	Remedy
9 Poor weld finish.	Inadequate shielding gas.	Increase gas flow or check gas line for gas flow problems.
10 Arc flutters during TIG welding.	A Tungsten electrode is too large for the welding current. B Absence of oxides in the weld pool.	A Select the right size electrode. Refer to Basic TIG Welding guide. B Refer Basic TIG Welding Guide for ways to reduce arc flutter.
11 Welding arc can not be established.	A Work clamp is not connected to the work piece or the work/torch leads are not connected to the right welding terminals. B Torch lead is disconnected. C Gas flow incorrectly set, cylinder empty or the torch valve is off.	A Connect the work clamp to the work piece or connect the work/torch leads to the right welding terminals. B Connect it to the '-' terminal. C Select the right flow rate, change cylinders or turn torch valve on.
12 Arc start is not smooth.	A Tungsten electrode is too large for the welding current. B The wrong electrode is being used for the welding job. C Gas flow rate is too high. D Incorrect shielding gas is being used. E Poor work clamp connection to work piece.	A Select the right size electrode. Refer to Basic TIG Welding Guide. B Select the right electrode type. Refer to Basic TIG Welding Guide. C Select the correct rate for the welding job. Refer to Basic TIG Welding Guide. D Select the right shielding gas. Refer to Basic TIG Welding Guide. E Improve connection to work piece.

4 Stick Welding Problems

Description	Possible Cause	Remedy
1 Gas pockets or voids in weld metal (Porosity).	A Electrodes are damp. B Welding current is too high. C Surface impurities such as oil, grease, paint, etc.	A Dry electrodes before use. B Reduce welding current. C Clean joint before welding.
2 Crack occurring in weld metal soon after solidification commences.	A Rigidity of joint. B Insufficient throat thickness. C Cooling rate is too high.	A Redesign to relieve weld joint of severe stresses or use crack resistance electrodes. B Travel slightly slower to allow greater build up in throat. C Preheat plate and cool slowly.
3 A gap is left by failure of the weld metal to fill the root of the weld.	A Welding current is too low. B Electrode too large for joint. C Insufficient gap. D Incorrect sequence.	A Increase welding current. B Use smaller diameter electrode. C Allow wider gap. D Use correct build-up sequence.

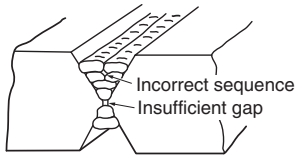


Figure 6-1: Example of insufficient gap or incorrect sequence

Description	Possible Cause	Remedy
4 Portions of the weld run do not fuse to the surface of the metal or edge of the joint.	A Small electrodes used on heavy cold plate. B Welding current is too low. C Wrong electrode angle. D Travel speed of electrode is too high. E Scale or dirt on joint surface.	A Use larger electrodes and pre-heat the plate. B Increase welding current. C Adjust angle so the welding arc is directed more into the base metal. D Reduce travel speed of electrode. E Clean surface before welding.

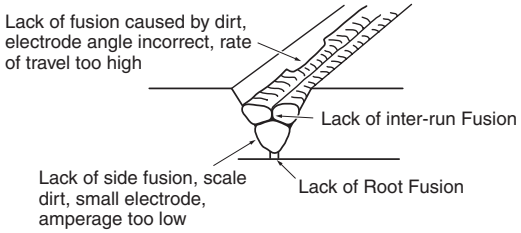


Figure 6-2: Example of lack of fusion

Description	Possible Cause	Remedy
5 Non-metallic particles are trapped in the weld metal (slag inclusion).	A Non-metallic particles may be trapped in undercut from previous run. B Joint preparation too restricted. C Irregular deposits allow slag to be trapped. D Lack of penetration with slag trapped beneath weld bead. E Rust or mill scale is preventing full fusion. F Wrong electrode for position in which welding is done.	A If bad undercut is present, clean slag out and cover with a run from a smaller diameter electrode. B Allow for adequate penetration and room for cleaning out the slag. C If very bad, chip or grind out irregularities. D Use smaller electrode with sufficient current to give adequate penetration. Use suitable tools to remove all slag from corners. E Clean joint before welding. F Use electrodes designed for position in which welding is done, otherwise proper control of slag is difficult.

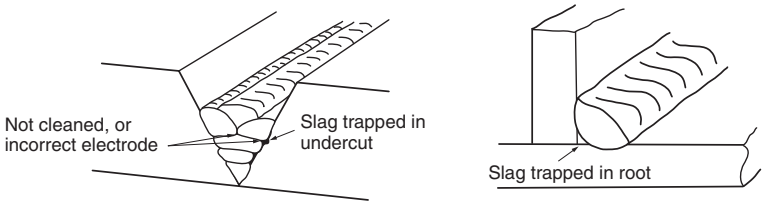


Figure 6-3: Examples of slag inclusion

5 Power Source Problems

	Description	Possible Cause	Remedy
1	The welding arc cannot be established.	A The Primary supply voltage has not been switched ON. B The Welding Power Source switch is switched OFF. C Loose connections internally.	A Switch ON the Primary supply voltage. B Switch ON the Welding Power Source. C Have an Accredited Thermal Arc Service Agent repair the connection.
2	Maximum output welding current can not be achieved with nominal Mains supply voltage.	Defective control circuit.	Have an Accredited Thermal Arc Service Agent inspect then repair the welder.
3	Welding current reduces when welding.	Poor work lead connection to the work piece.	Ensure that the work lead has a positive electrical connection to the work piece.
4	No gas flow when the torch trigger switch is depressed.	A Gas hose is cut. B Gas passage contains impurities. C Gas regulator turned off. D Torch trigger switch lead is disconnected or switch/cable is faulty.	A Replace gas hose. B Disconnect gas hose from the rear of Power Source then raise gas pressure and blow out impurities. C Turn gas regulator on. D Reconnect lead or repair faulty switch/ cable.
5	Gas flow won't shut off.	A Weld Mode (STD, SLOPE, REPEAT or SPOT) was changed before POST-FLOW gas time had finished. B Gas valve is faulty. C Gas valve jammed open. D POST-FLOW control is set to 60 sec.	A Strike an arc to complete the weld cycle. OR Switch machine off then on to reset solenoid valve sequence. B Have an Accredited Thermal Arc Service Agent replace gas valve. C Have an Accredited Thermal Arc Service Agent repair or replace gas valve. D Reduce POST-FLOW time.
6	The TIG electrode has been contaminated due to the gas flow shutting off before the programmed POST-FLOW time has elapse.	The Weld Process Mode (STICK, HF TIG or LIFT TIG) was changed before POST-FLOW gas time had finished.	Do not change Weld Process Mode before the POST-FLOW gas time had finished.

7 VOLTAGE REDUCTION DEVICE (VRD)

1 VRD Specification

Description	ArcMaster 400MST	Notes
VRD Open Circuit Voltage	15.3 to 19.8V	Open circuit voltage between welding terminals.
VRD Resistanc.	148 to 193 ohms	The required resistance between welding terminals to turn ON the welding power.
VRD Turn OFF Time	0.2 to 0.3 seconds	The time taken to turn OFF the welding power once the welding current has stopped.

2 VRD Maintenance

Routine inspection and testing (power source)

An inspection of the power source, an insulation resistance test and an earth resistance test shall be carried out.

a. For transportable equipment, at least once every 3 months

b. For fixed equipment, at least once every 12 months.

The owners of the equipment shall keep a suitable record of the periodic tests.

NOTE

A transportable power source is any equipment that is not permanently connected and fixed in the position in which it is operated.

In addition to the above tests and specifically in relation to the VRD fitted to this machine, the following periodic tests should also be conducted by an accredited Thermal Arc service agent.

Description	IEC 60974-1 Requirements
VRD Open Circuit Voltage	Less than 20V; at Vin=230V or 460V
VRD Turn ON Resistance	Less than 200 ohms
VRD Turn OFF Time	Less than 0.3 seconds

If this equipment is used in a hazardous location or environments with a high risk of electrocution then the above tests should be carried out prior to entering this location.

3 Switching VRD On/Off

Switch the machine Off.

a. Remove the clear plastic cover from the control panel (see Figure 7-1).
   - Lift up the cover so it rests on the top of the unit.
   - Place a small flat bladed screw driver between the cover hinge on the front panel.
   - Gently lift the cover hinge out of the front cover mounting hole.
   - Remove the control's clear plastic cover.

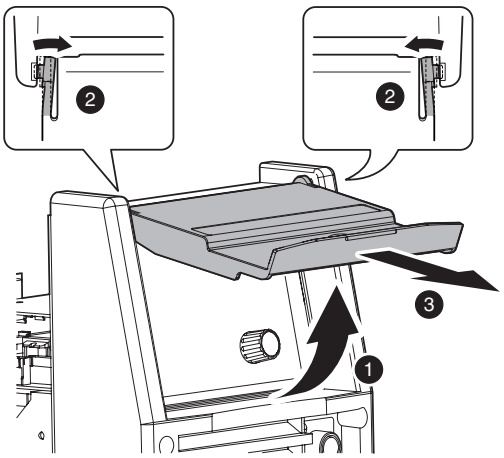


Figure 7-1: VRD ON/OFF Step A

b. Remove four mounting screws from the control panel (see Figure 7-2).

c. Access the VRD control by gently prying back the front panel controls to reveal the VRD on/off potentiometer (see Figure 7-2).

CAUTION

Do not pull back the front panel with excessive force as this will unplug control PCB. Plugging the control PCB back into the front panel controls can only be achieved by removing the side covers.

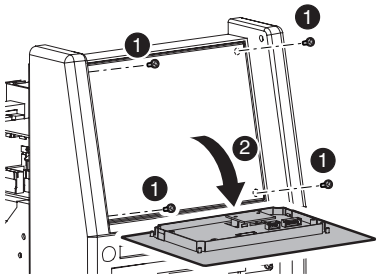


Figure 7-2: VRD ON/OFF Step B,C

d. Turning the VRD ON/OFF (see Figure 7-3).

- To turn VRD ON: rotate the trim potentiometer (VR1) on the display PCB fully clockwise. When VRD is turned ON check that it operates as per VRD Specifications on page 7-1.
- To turn VRD OFF: rotate the trim potentiometer (VR1) on the display PCB fully counter clockwise.

WARNING

The VRD ON/OFF trim potentiometer MUST ONLY be positioned fully clockwise OR fully counter clockwise as the VRD function will be unknown for every other position.

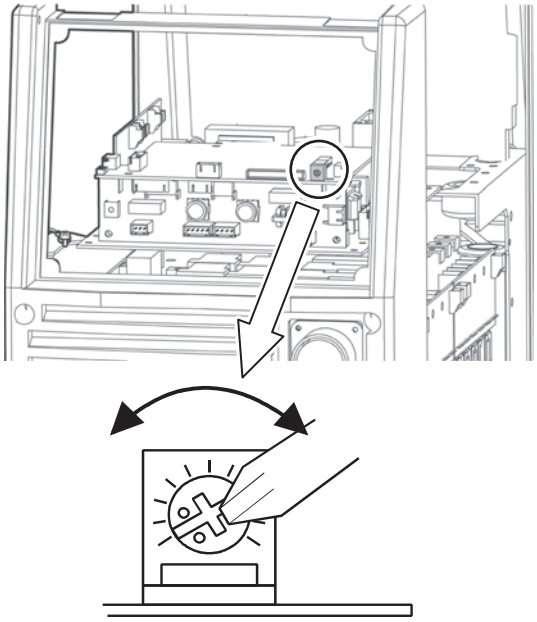


Figure 7-3: VRD ON/OFF Step D

8 POWER SOURCE ERROR CODES

	Description	Possible Cause	Remedy	Remarks
1	E01 error code displayed Temperature sensor TH1 (protects IGBTs) is greater than 80°C for about 1 second.	A The Welding Power Source's duty cycle has been exceeded. B Fan ceases to operate. C Air flow is restricted by vents being blocked.	A Let Power Source cool down then keep within its duty cycle. B Have an Accredited Thermal Arc Service Agent investigate. C Unblock vents then let Power Source cool down.	Weld current ceases. Buzzer sounds constantly. Fan operates at max speed. E01 resets when TH1 decreases to 70°C for about 30 seconds.
2	E02 error code displayed Temperature sensor TH2 (protects secondary diodes) is greater than 80°C for about 1 second.	A The Welding Power Source's duty cycle has been exceeded. B Fan ceases to operate. C Air flow is restricted by vents being blocked.	A Let Power Source cool down then keep within its duty cycle. B Have an Accredited Thermal Arc Service Agent investigate. C Unblock vents then let Power Source cool down.	Weld current ceases. Buzzer sounds constantly. Fan operates at max speed. E02 resets when TH1 decreases to 70°C for about 30 seconds.
3	E03 error code displayed Primary (input) current too high.	A Primary current is too high because welding arc is too long. B Mains supply voltage is more than 10% below nominal voltag.	A Reduce length of welding arc. B Have an Accredited Thermal Arc Service Agent or a qualified electrician check for low Mains voltage.	Weld current ceases. Buzzer sounds constantly. Switch machine off then on to reset E03 error.
4	E11 error code displayed Over Primary supply (input) voltage at primary capacitors is exceeded for one second.	Primary supply voltage is greater than the nominal voltage plus 10%.	Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Primary voltage.	Weld current ceases. Buzzer sounds constantly. Error code E11 automatically will reset when the voltage reduces.
5	E14 error code displayed Under mains supply (input) voltage warning primary capacitors is reduced for one second.	Mains supply voltage is less than the nominal operating voltage less 10%.	Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Mains voltage.	Weld current available. Buzzer sounds intermittently. Error code E14 automatically will reset when the voltage increases.
6	E12 error code displayed Under mains supply (input) voltage primary capacitors is reduced for one second.	Mains supply voltage is down to a dangerously low level.	Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Mains voltage.	Weld current ceases. Buzzer sounds constantly. Error code E12 automatically will reset when the voltage increases.
7	E81 error code displayed Wrong Primary supply (input) voltage connected.	When 3 phase machine is first turned on with the wrong Primary supply (input) voltage connected.	Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Mains voltage.	No weld current is available. Buzzer sounds constantly. Switch machine off.
8	E82 error code displayed Link switch plug not connected.	Link switch plug not connected.	Have an Accredited Thermal Arc Service Agent check connector plug on input PCB.	No weld current is available. Buzzer sounds constantly. Switch machine off.
9	E83 error code displayed CPU checks mains supply (input) voltage when the on/off switch on rear panel of machine is turned ON.	The Primary supply (input) voltage fluctuates and is not stable.	Have an Accredited Thermal Arc Service Agent check connector plug on input PCB and the Mains voltage.	No weld current is available. Buzzer sounds constantly. Switch machine off then on to reset E83 error.

Description	Possible Cause	Remedy	Remarks
10 E93 error code displayed Memory chip (EEPROM) on control PCB can not read/write weld parameter.	Memory chip (EEPROM) error.	Have an Accredited Thermal Arc Service Agent check the control PCB.	Weld current ceases. Buzzer sounds constantly. Switch machine off.
11 E94 error code displayed Temperature sensor TH1 for IGBTs or sensor TH2 for secondary diodes are open circuit.	The Welding Power Source's temperature sensors have malfunctioned.	Have an Accredited Thermal Arc Service Agent check or replace the temperature sensors.	Weld current ceases. Buzzer sounds constantly. Switch machine off.
12 E99 error code displayed Mains supply (input) voltage has been turned off but control circuit has power from the primary capacitors.	A Main on/off switch on machine has been turned off. B Mains supply (input) voltage has been turned off.	A Turn on/off switch on. B Have an Accredited Thermal Arc Service Agent or a qualified electrician check the Mains voltage and fuses.	Weld current ceases. Buzzer sounds constantly. Must switch machine off then on to reset E99 error.

9 ADVANCED TROUBLESHOOTING

If you are here, all of the troubleshooting suggestions in Section 7 Basic Troubleshooting have either failed to resolve the faulty operation or have indicated that one or more of the subsystems within the power supply are defective. This section provides the information needed to take live measurements on the various subsystems within the power supply, and replace those subsystems that prove faulty.

CAUTION

Troubleshooting and repairing this unit is a process, which should be undertaken only by those familiar with high voltage/high power electronic equipment.

WARNING

There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have training in power electronics, measurement and troubleshooting techniques.

Under no circumstances are field repairs to be attempted on printed circuit boards or other subassemblies of this unit. Evidence of unauthorized repairs will void the factory warranty. If a subassembly is found to be defective by executing any of the procedures in this Service Manual, the subassembly should be replaced with a new one. The faulty subassembly should then be returned to Thermal Arc through established procedures.

WARNING

Disconnect primary power at the source before disassembling the power supply. Frequently review the "Principal Safety Standards" in section 1.02.
Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the work piece or any internal components while the unit is activated.

1 System-Level Fault Isolation

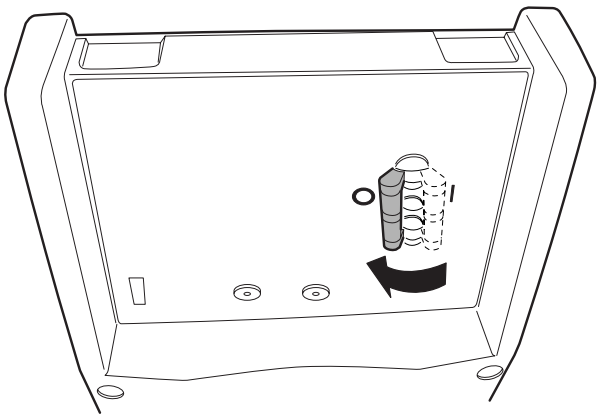
If none of the suggestions provided in Section 7 have solved the problem or corrected the faulty operation, the next step is to isolate one or more of the internal subassemblies that may be defective.

CAUTION

Perform all steps in each procedure, in sequence. Skipping portions of procedures, or performing steps out of sequence can result in damage to the unit, and possible injury, or worse, to the operator.

1.1 Opening the Enclosure

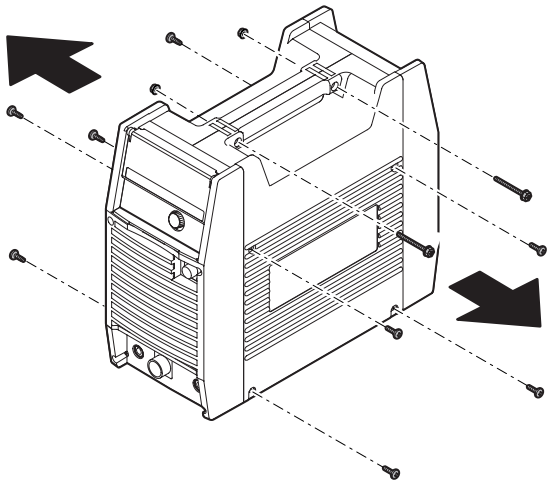
1) Confirm that the switch on the power supply and the switch on the switchboard (distribution panel) are all OFF.



CAUTION

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete.

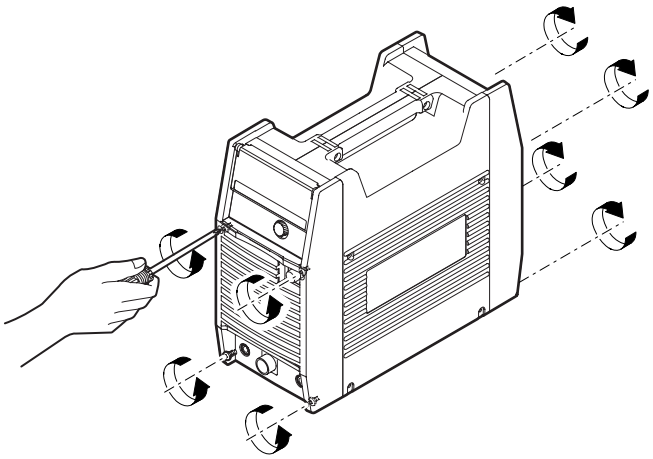
2) Remove all screws and nuts on the side covers.



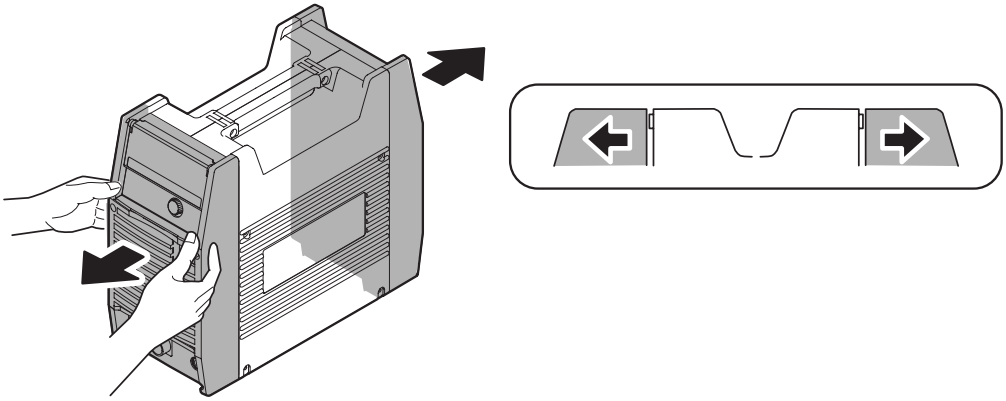
3) Loosen the screws on the front panel and the rear panel by turning them approximately two turns CCW.

NOTE

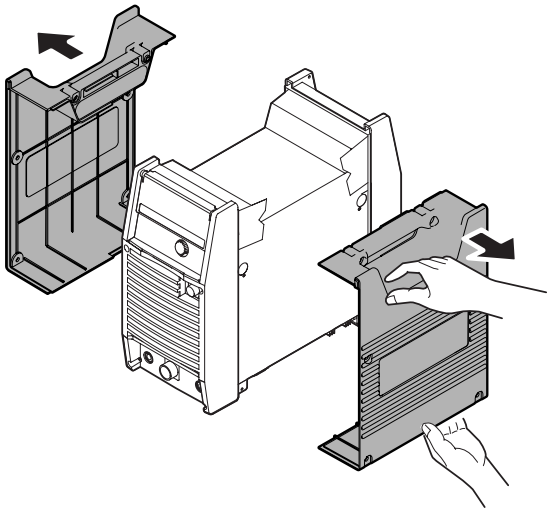
DO NOT remove the screws completely.



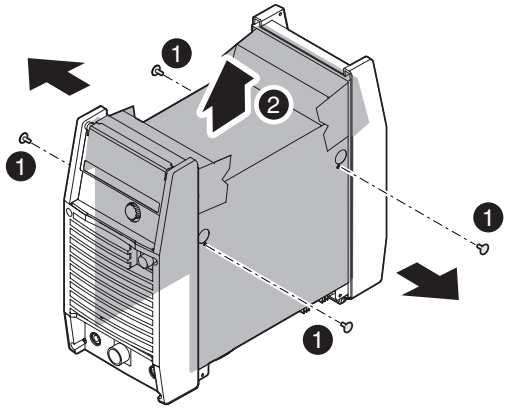
4) Pull the front panel slightly forward and pull the rear panel slightly backward.
The interlocking hooks of the side case covers can now be disengaged from the front and rear panels.



5) Remove the side covers.



6) Remove protection cover sheet by removing the plastic tabs.



NOTE

When you re-assemble the parts, conduct the above process backwards.

1.2 Verification and Remedy to the Indicated Error Codes

NOTE

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete and then remove the cases to continue your inspection and repair (or maintenance) inside the power supply. As for the removal and installation of the case, refer to section 9.1.1.

NOTE

During the "Verification/Remedy" procedures below, follow the alphabetical sequence (a, b, c...) and proceed with your verification and confirmation.

NOTE

After you confirm and replace all spare parts and components, confirm that there are no damaged harnesses or connectors, uninstalled or loose screws.

1.2.1 E01 "Over-Temperature at the primary side"

Cause

Occurs when an over-temperature condition of the primary IGBT is detected.

Verification/Remedy

a) Unit may be in thermal shutdown mode.
- Review the rated duty cycle of the unit per page 2-4. Exceeding the duty cycle can damage the unit and void the warranty. Refer also to section 2.7 for additional information.

b) Verify the ventilating condition.
- Maintain a clear and unobstructed distance of more than 12 in. in the front and more that 20 in. in the rear of the unit for ventilation purposes.
- Verify and maintain clean, dust free, front and rear airflow paths. Cleaning and removing dust from the front and rear panels once every six months in a normal working environment is recommended. Extremely dusty environments will require more frequent cleanings.

c) Verify the operation of the cooling fan, FAN1, and replace it if necessary.
- Verify the condition of FAN1. Verify that there are no broken or cracked fan blades and that FAN1 is not producing any abnormal sounds.
- If broken or cracked FAN1 blades, or abnormal sounds are emanating from FAN1, replace FAN1.
- Refer to section 9.2.4.19 for the replacement of FAN1.
- Refer to section 9.1.4.4 for additional FAN1 tests.
- Verify the operation of the cooling fan and replace it if the condition of FAN1 is inactive. Follow the instruction in section 9.1.4.4.

d) Replace PCB3 (WK-5548).
- Refer to section 9.2.4.3 for the replacement of PCB3.

1.2.2 E02 "Over-Temperature at the secondary side"

Cause

Occurs when an over-temperature condition of the secondary IGBT and diode are detected.

Verification/Remedy

a) Unit may be in thermal shutdown mode.
- Review the rated duty cycle of the unit per section 2.6. Exceeding the duty cycle can damage the unit and void the warranty. Refer also to section 2.7 for additional information.

b) Verify the ventilating condition.
- Maintain a clear and unobstructed distance of more than 12 in. in the front and more that 20 in. in the rear of the unit for ventilation purposes.
- Verify and maintain clean, dust free, front and rear airflow paths. Cleaning and removing dust from the front and rear panels once every six months in a normal working environment is recommended. Extremely dusty environments will require more frequent cleanings.

c) Verify the operation of the cooling fan, FAN1, and replace it if necessary.
- Verify the condition of FAN1. Verify that there are no broken or cracked fan blades and that FAN1 is not producing any abnormal sounds.
- If broken or cracked FAN1 blades or abnormal sounds are emanating from FAN1, replace FAN1.
- Refer to section 9.2.4.19 for the replacement of FAN1.
- Refer to section 9.1.4.4 for additional FAN1 tests.
- Verify the operation of the cooling fan and replace it if the condition of FAN1 is inactive. Follow the instruction in section 9.1.4.4.

d) Replace PCB3 (WK-5548).
- Refer to section 9.2.4.3 for the replacement of PCB3.

1.2.3 E03 "Primary Over-Current Failure"

Cause

Occurs when excessive current is detected flowing into the primary side of the main transformer.

Verification/Remedy

a) Confirm the operation of the machine within the rated specification.
- Refer to the specification data sheet in Section 2.6.

b) Verify the secondary diode (D2, D3, D4, D5,)
- Refer to section 9.1.4.6 for the test and replacement of D2 and to section 9.2.4.24 for D3, D4, D5.

c) Replace the Hall CT, HCT1.

NOTE

Pay special attention to installed direction of HCT1. The Hall CT will not function properly if installed in the incorrect direction.

- Refer to section 9.2.4.22 for the replacement of HCT1.

1.2.4 E11 "High Input Voltage Failure"

Cause

Occurs when the input voltage is more than approximately 275VAC (at input voltage 230V) or 520VAC (at input voltage 460V) (=1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 9.1.4.2.

b) Replace PCB4 (WK-4819).
- If the voltage and current available is determined to be sufficient, replace PCB4.
- Refer to section 9.2.4.4 for the replacement of PCB4.

1.2.5 E12 "Low Input Voltage Failure"

Cause

Occurs when the input voltage is less than approximately 150VAC (=1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 9.1.4.2.

b) Replace PCB4 (WK-4819).
- If the voltage and current available is determined to be sufficient, replace PCB4.
- Refer to section 9.2.4.4 for the replacement of PCB4.

1.2.6 E14 "Low Input Voltage Warning"

Cause

Occurs when the input voltage is less than approximately 173VAC (=1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 9.1.4.2.

b) Replace PCB4 (WK-4819).
- If the voltage and current available is determined to be sufficient, replace PCB4.
- Refer to section 9.2.4.4 for the replacement of PCB4.

1.2.7 E81 "Abnormal Input Voltage"

Cause

Failure detected by the input voltage detection circuit, etc.

Verification/Remedy

a) Verify the AC input voltage using a voltmeter.
- Follow the instruction in section 9.1.4.2.

b) Verify the wiring harness and connection of CN1 on PCB16 (WK-4917) and CN2 on PCB3 (WK-5548).
- Confirm a secure connection of the harness between CN1 on PCB16 and CN2 on PCB3.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

c) Verify PCB4 (WK-4819) for burned or discolored components or printed circuit board.
- Confirm that the PCB is securely fastened in place. (No loose screws).
- Refer to section 9.2.4.4 for the replacement of PCB4.

1.2.8 E82 "Rated voltage selection circuit abnormality"

Cause

Failure detected by the input voltage detection circuit, etc.

Verification/Remedy

a) Verify the wiring harness and connection of CN4 on PCB4 (WK-4819).
- Confirm a secure connection of CN4 on PCB4.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Verify PCB4 (WK-4819) for burned or discolored components or printed circuit board.
- Confirm that the PCB is securely fastened in place. (No loose screws).
- Refer to section 9.2.4.4 for the replacement of PCB4.

1.2.9 E83 "Abnormal mains supply voltage"

Cause

Failure detected by the input voltage detection circuit, etc.

Verification/Remedy

a) Verify the AC input voltage using a voltmeter.
- Follow the instruction in section 9.1.4.2.

b) Verify the wiring harness and connection of CN1 on PCB16 (WK-4917) and CN2 on PCB3 (WK-5548).
- Confirm a secure connection of the harness

between CN1 on PCB16 and CN2 on PCB3.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

c) Verify PCB4 (WK-4819) for burned or discolored components or printed circuit board.
- Confirm that the PCB is securely fastened in place. (No loose screws).
- Refer to section 9.2.4.4 for the replacement of PCB4.

1.2.10 E85 "Pre-Charge Error"

Cause

Occurs, after you apply power, when a failure is detected during the preliminary charging of the capacitors.

Verification/Remedy

a) Verify the AC input voltage and the Capacitor Bus Voltage on PCB2 (WK-5597).
- Follow the instruction in section 9.1.4.2.

b) Verify the input diode, D1.
- Refer to section 9.1.4.5 for the test and replacement of D1.

c) Verify the IGBT, Q1-Q24.
- Refer to section 9.1.4.7 for the test and sections 9.2.4.7 and 9.2.4.8 for replacement of Q1, Q2, ..., Q23, and Q24.

d) Replace PCB2 (WK-5597) and PCB4 (WK-4819).
- If the tests in the above sections (a, b, c) are within expected results and the unit is still defective, replace PCB2 and PCB4.
- Refer to section 9.2.4.2 and 9.2.4.4 for the replacement of PCB2 and PCB4.

1.2.11 E94 "Thermistor Failure"

Cause

Occurs when the thermistor for the temperature detection circuitry is open.

Verification/Remedy

a) Verify the wiring harness and connection between CN8 and CN9 on PCB6 (WK-5688) and thermistors TH1 and TH2.
- Confirm a secure connection of the harness wired between CN8 and CN9 on PCB6 and TH1 and TH2 and re-install the harnesses with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Replace thermistors, TH1 and TH2.
- Refer to section 9.2.4.17 and 9.2.4.18 for the replacement of TH1 and TH2.

c) Replace PCB6 (WK-5688).
- Refer to section 9.2.4.6 for the replacement of PCB6.

1.2.12 E99 "Initial Power Receiving"

Cause

Occurs when the initial AC power-received signal has not reached the CPU.

NOTE

This error occurs normally during the power "OFF" sequence of the unit.

Verification/Remedy

a) Verify the wiring harness and connection of CN1 on PCB16 (WK-4917) and CN2 on PCB3 (WK-5548).
- Confirm a secure connection of the harness wired between CN1 on PCB21 and CN2 on PCB3 and re-install the harness with a secure connection.
- Contact the manufacturer if you find any broken connectors or a damaged wiring harness.

b) Verify and replace PCB4 (WK-4819).
- During the installation of PCB4 and PCB3, confirm that the PCB's are securely fastened in place. (No loose screws).
- Refer to section 9.2.4.4 for the replacement of PCB4.

c) Replace PCB6 (WK-5688).
- Refer to section 9.2.4.6 for the replacement of PCB6.

1.3 Verification and Remedy to Failures without Indication Codes

Refer to Notes on Page 9-4.

1.3.1 "Cooling Fan Failure" (Fan is not rotating)

Cause

Occurs when the cooling fan is defective, damaged or the driving voltage is incorrect.

Verification/Remedy

a) Verify the cooling fan, FAN1.
- Inspect the condition of the fan blades and all peripheral parts. Clean the fan blades and all peripheral parts if covered with dust. Cleaning and removing dust from the fan blades once every 6 months in a normal environment is recommended. Extremely dusty environments will require more frequent cleanings.
- Verify that there are no wiring harnesses entangled inside the fan, confirm that the harnesses do not have any brakes in the wire or damaged connectors.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.
- Replace the fan if there are any broken, cracked or missing fan blades.
- Refer to section 9.2.4.19 for replacement of FAN1.

b) Verify the wiring harness between the cooling fan (FAN1) and CN11 on PCB3 (WK-5548).
- Confirm a secure connection of the harness to CN11 on PCB3.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

c) Cooling fan voltage tests and replacement of the cooling fan (FAN1).
- Follow the instruction in section 9.1.4.4.

1.3.2 "Wire feeding failure or inconsistent wire delivery" (Wire feeder does not work)

Cause

Power Source: Faulty or damaged 14-pin receptacle and 19-pin receptacle, tripped or damaged the circuit breaker (MCB1, MCB2), blown down-transformer, associated wiring.

Wire Feeder: Feeder gear failure. Refer to the wire feeder operator manual, supplied by the wire feeder manufacturer, for additional information.

Verification/Remedy

a) Confirm wire setting.

b) Verify CON1 of 14-pin receptacle (CON2 of 19-pin receptacle). * Applies to MIG mode.
- Confirm the wiring harness and connections between CON1 of 14-pin receptacle (or CON2 of 19-pin receptacle) and the wire feeder device are secure.
- Confirm the wiring harness and connections between CON1 of 14-pin receptacle (or CON2 of 19-pin receptacle) and PCB17 (WK-5699).
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.
- Confirm that the voltage between pin "I" and pin "G" of the 14-pin CON1 receptacle is AC115V (AC100~125V).
- Confirm that the voltage between pin "E" and pin "F" of the 19-pin CON2 receptacle is AC115V (AC100~125V).

- Confirm the pin-out numbers of the 14-pin receptacle (or 19-pin receptacle) located on the wire feeder equipment. (Refer to section 3.1.)
- Confirm the wiring and connections on the 14-pin receptacle (or 19-pin receptacle) located on the wire feeder equipment.

c) Verify the circuit breaker used for the wire feeder equipment power supply, MCB1 and MCB2.

- Confirm whether MCB1 or MCB2 has tripped or not. (When the MCB trips, the yellow knob will be exposed.)

NOTE

If the circuit breaker of the wire feeder power supply has tripped, there are other possible failures that must be considered. For example, the capacity of the wire feeder equipment motor is large, or there are some other problems in the wire feeder equipment. Before continuing onto the next section, verify and eliminate the above possible failure conditions. Refer the operating manual supplied by the wire feeder manufacture.

- Press the yellow knob down AFTER the faults in the wire feeder equipment are resolved.
- If the wire feeder equipment still does not operate, verify MCB1 and MCB2. Replace them if necessary.
- Refer to section 9.2.4.27 for the replacement of MCB1 and MCB2.

d) Verify the transformer, T1, and replace it if necessary.

- Refer to section 9.2.4.29 for the replacement of T1.

e) Verify the wire feeder equipment, and replace it if necessary.

- Refer to the operating manual supplied by the wire feeder manufacture before any work is performed on the wire feeder.

1.3.3 "No weld output"

Cause

Occurs when the 14-pin receptacle (19-pin receptacle) or associated circuitry is defective, damaged, or the TIG torch cable is defective and Wire feeder Abnormality.

Verification/Remedy

CAUTION

Read and understand this entire section before proceeding. Extreme personal harm and test equipment damage will occur if the procedures are not performed accurately.

a) Verify the 14-pin receptacle. * Applies to LIFT TIG and MIG mode.

- Confirm a secure connection between CON1 of the 14-pin receptacle and the wire feeder.
- Confirm a secure connection between CON1 of the 14-pin receptacle and the remote device.
- Confirm a secure connection of the harness and the connections between CON1 and PCB17 (WK-5699) are all correct and there are no open circuit.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.
- Confirm the proper pin-outs of the 14-pin receptacle on the wire feeder side. (Refer to section 3.1.)
- Confirm the proper pins-outs of the 14-pin receptacle on the remote device side. (Refer to section 3.1.)
- Confirm that the wire feeder has no open circuit on the 14-pin receptacle at the remote device side.

b) Verify the condition and connect the connections of the welding cable, the stick rod holders and the base metal cables. * Applies to STICK and LIFT TIG mode.

- Confirm a secure connection of the welding cable, stick rod holders, base metal cables and dinse connectors and there are no open circuits.

c) Verify the cables connected to the wire feeder equipment including welding and base metal cables. * Applies to MIG mode only.

- Confirm the connections of the required cables; control cable for the wire feeder equipment, cable for welding, and a cable for the base metal are all secured.
- Confirm that there are no connection errors or broken wires of the required cables; control cable for the wire feeder equipment, cable for welding, and a cable for the base metal.

d) Verify the no-load voltage (OCV). ∗Applies to STICK and MIG mode.
- Refer to section "Verification of No-Load voltage (OCV)" in the section 9.1.4.8 first before continuing this section.
- If performing the "No-Load Voltage Failure" procedure does not rectify the failure, perform the following tests in the sequence below. Replace any defective components found.
  1) Diode, D2, D3, D4 and D5. (Refer to the Section 9.1.4.6)
  2) Reactor, FCH. Confirm the connection of FCH and PCB14 (WK-5594). (Refer to the Section Appendix 3)
  3) PCB8, PCB9, PCB10, PCB11 (WK-5479). (Refer to the Section 9.2.4.7 and 9.2.48)
  4) Hall CT, HCT1. Confirm the connection of FCT1 and PCB6 (WK-5688). (Refer to the Section 9.2.4.22)

e) Verify the wire feeder equipment, and replace it if necessary.
- Refer to the operating manual supplied by the wire feeder manufacture before any work is performed on the wire feeder.

1.3.4 "Operating Panel Failure" (LED's do not light properly or weld settings cannot be established.)

Cause

Occurs when there is a connection failure among PCB3 (WK-5548), PCB6 (WK-5688) and PCB12 (WK-5527) or PCB3, PCB6 and PCB12 are defective.

Verification/Remedy

a) Verify the PCB connection between CN21 on PCB6 (WK-5688) and CN2 on PCB12 (WK-5527).
- Confirm a secure connection of the harness and the connections between CN21 on PCB6 and CN2 on PCB12.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Verify the connection between PCB5 (WK-5696) and PCB6 (WK-5688).
- Confirm that all three connectors between PCB5 and PCB6 are tightly connected.
- Confirm the condition of the pins on the connectors and the connectors themselves. If bent pins or damaged connectors are found, replace the suspected PCB.
- Refer to section 9.2.4.5 and 9.2.4.6 for the replacement and installation of PCB5 and PCB6.

c) Replacement of PCB6 (WK-5688) and PCB12 (WK-5527).
- Refer to section 9.2.4.6 for the replacement and installation of PCB6 and section 9.2.4.9 for PCB12.

1.4 Fault Isolation Tests

1.4.1 Preparation

The following initial conditions must be met prior to starting any of the procedures in this section (9.1.4).

1) Connect the appropriate input voltage. (Check the name plate on the rear of the power supply for the proper input voltage.)

NOTE

Operate at ALL input voltages as noted on the nameplate on the rear panel when testing the power supply.

2) Close primary power source wall disconnect switch or circuit breaker.
3) Place power supply MAIN CIRCUIT SWITCH (S1) on rear of unit in the ON position.

⚠ WARNING

Dangerous voltage and power levels are present inside this unit. Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece or any internal components while the unit is activated.

1.4.2 Verification of the Power Input Circuitry

1) Verify the AC input voltage using an AC voltmeter

   Verify input voltage (Phase-to Phase) using an AC voltmeter. (The capability of the voltmeter should be more than 600VAC). Measure the point between lines U1 and V1 on the input switch, S1.

   Measure the point between lines U1 and W1 on the input switch, S1. Measure the point between lines V1 and W1 on the input switch, S1.

   The location of points U1, V1 and W1 on switch S1 are indicated in Figure 9-1.

   When using a single-phase connection, the voltage can be verified only between U1 and V1.

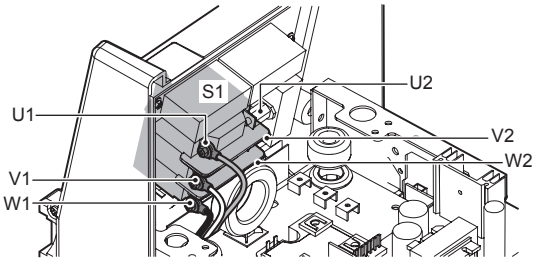


Figure 9-1: Check points U1, U2, V1, V2, W1 and W2

2) If the input voltage is out of the operating range of the unit, which is ±10% (187~253/414~506 VAC) of the rated voltage (208, 230/460V), verify the available power capacity at the installed site.

   If the input voltage is within the operating range, recheck the input voltage while welding, as welding may cause the input voltage to decrease to a value below the operating range of the unit.

3) Verify input voltage after the input switch (S1) using an AC voltmeter. (The capability of the voltmeter should be more than 600VAC.)

   - Using an AC voltmeter, measure between the points U2 and V2 on the input switch, S1.
   - Using an AC voltmeter, measure between the points U2 and W2 on the input switch, S1.
   - Using an AC voltmeter, measure between the points V2 and W2 on the input switch, S1.

   The location of points U2, V2 and W2 on switch S1 are indicated in Figure 9-1. When using a single-phase connection, the voltage can be verified only between U2 and V2.

4) If this voltage is out of the operating range, which is ±10% (187~253/414~506 VAC) of the rated voltage (208, 230/460V), replace S1 following the process in section 9.2.4.20.

5) Verify the rectified output voltage of the input diode, D1 using a DC voltmeter. (The capability of the voltmeter should be more than 1000VDC.)

   Using a DC voltmeter, measure between the points 1 (P) [+] and 2 (N) [-] on D1.

   Points 1 (P) and 2 (N) are on D1.

   See Figure 9-2.

   The measured voltage should be approximately 1.4 times larger than input voltage measured in #1 above. Replace diode D1 if the calculated measurement is not within the corresponding range (260~360/580~720VDC) following the process in section 9.2.4.23.

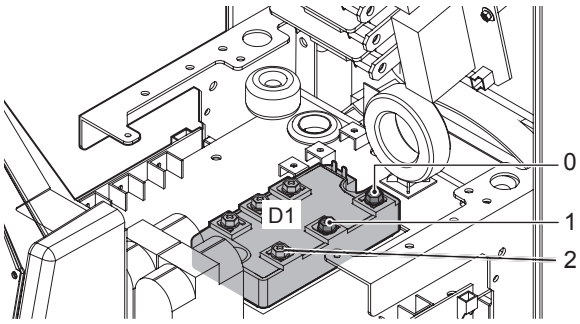


Figure 9-2: The check points 1 (P) and 2 (N)

6) Verify bus voltage (the voltage of the electrolytic capacitor after rectification) using a DC voltmeter. (The capability of the DVM should be more than 1000VDC.)

   Using a DC voltmeter, measure between the output studs C and E on PCB8 (WK-5479), PCB9 (WK5479), PCB10 (WK-5479) and PCB11 (WK5479).

   See Figure 9-2.

   The measured voltage should be approximately 1.4 times larger than the input voltage measured in #1 above, except when running at 460V where the bus voltage will be shared across all boards, ie, each board receiving 0.7 times the input voltage measured in step 1 above. Replace diode D1 if the

calculated measurement is not within the corresponding range (260~360/580~720VDC) following the process in section 9.2.4.23.

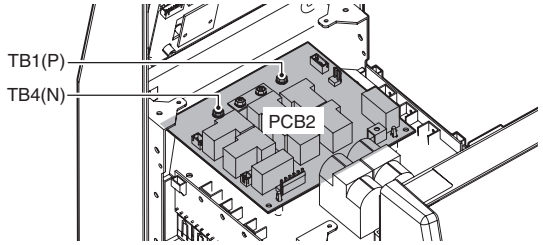


Figure 9-3: The check points TB1(P) and TB4(N)

7) After the replacement of D1, if the above voltage is still abnormal, replace PCB1 (WK-5493).

1.4.3 Power Supply Voltage Test

Connect the power supply to a source of rated input voltage. (Check the name plate on the rear of the power supply for the proper input voltage.)

Apply power to the unit and place the switch of the power supply to the ON position.

On the PCB6 (WK-5549) and PCB3 (WK-5548), measure the voltages according to the following table. The test point and the reference are obtainable on the parts side of PCB6 (WK-5549) and PCB3 (WK-5548).

The location of points TP0-3 are indicated in Figure 9-4.

The location of points PIN1-PIN3 of CN18 on PCB3 are indicated in Figure 9-5.

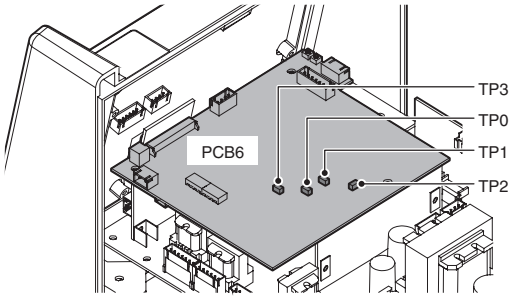


Figure 9-4: The check points TP0-3

Test Point (PCB6;WK-5688)	Reference (PCB6;WK-5688)	ACCEPTABLE VALUE
TP1	TP0	+15VDC
TP2	TP0	+5VDC
TP3	TP0	–15VDC

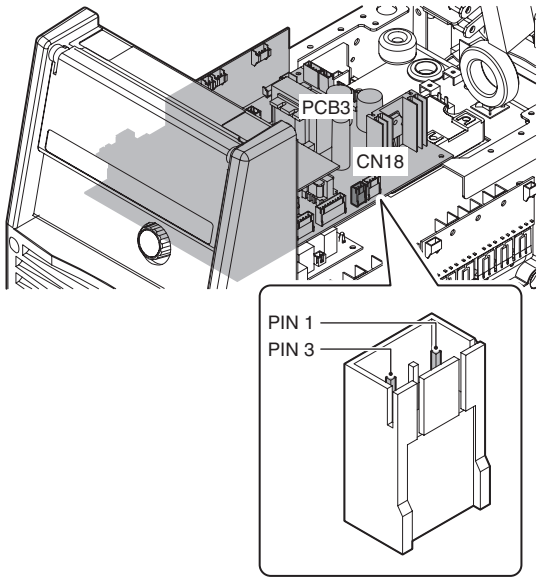


Figure 9-5: The check points PIN1-PIN3 of CN18 on PCB3

Test Point (CN18 on PCB3; WK-5548)	Reference (CN18 on PCB3; WK-5548)	ACCEPTABLE VALUE
PIN1	PIN3	+24VDC

If any of these voltages are not present or are below a 10% tolerance, replace PCB3 (WK-5548).

1.4.4 Verification of the Cooling Fan, FAN1, Drive Circuitry

Verify the condition of the cooling fan, FAN1, using a DC voltmeter. (The capability of the voltmeter should be more than 50VDC.)

Using a DC voltmeter, measure between PIN 1[+] and PIN 2[-] of CN11 on PCB3 (WK-5548).

The location of connector CN11 of PCB3 (WK-5548) is indicated in Figure 9-6.

NOTE

When you measure the above voltage, do not remove the connector. Conduct the measurement while the connector plug and receptacle are still connected.

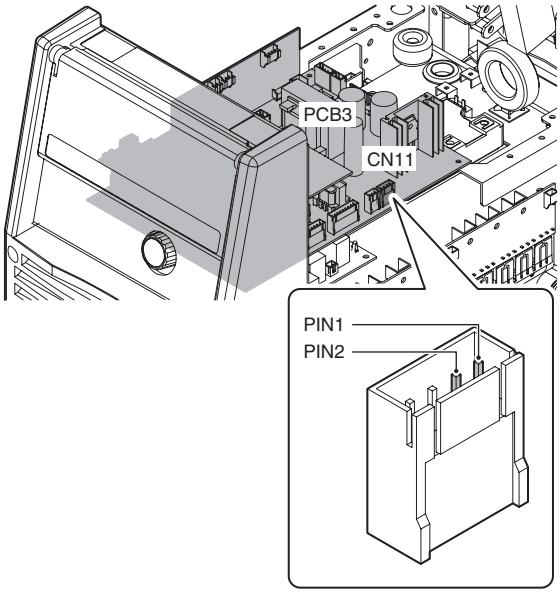


Figure 9-6: The location of connector CN11 of PCB3 (WK-5548)

Using the measurement taken above, follow the chart below for possible failure modes.

	Fan Status	Voltage measurement (PIN1-PIN2 of CN11 on PCB3)	Remedy
Case 1	Rotating	DC 18~25V	Fan drive circuit is normal.
Case 2	Rotating	Below DC 18V	Replace PCB3 (WK-5548). (Refer to section 9.2.4.3)
Case 3	Inactive	Below DC 18V	Replace PCB3 (WK-5548). (Refer to section 9.2.4.3) ↓ Conduct the "Verification of the power input circuitry" in section 9.1.4.2.
Case 4	Inactive	DC 18~25V	Replace FAN1. (Refer to section 9.2.4.19)

NOTE

This welding unit has a feature that will slow the rotational speed of the cooling fan during low output current and while in standby. Under these conditions, the voltages in the above table will be inaccurate; therefore, when verifying the voltage, do so during the failure condition.

NOTE

When verifying the voltage, confirm that the AC input voltage remain within the operating range of the unit. (The AC input does not drop below 180VAC).

1.4.5 Verification of the primary Diode (D1)

CAUTION

Before performing any portion of the procedure below, make certain unit is placed in the initial set up condition as described in section 9.1.4.1 "Preparation".

1. Verify the characteristic of the primary diode, D1, using a diode tester.
2. Refer to Table 9-1 and Figure 9-7, 9-8 for the checkpoints on D1.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Diode of D1	3, 4, 5 0	0 3, 4, 5	0.3 to 0.5V Open
Diode of D1	3, 4, 5 2	2 3, 4, 5	Open 0.3 to 0.5V
Thyristor of D1	0 1	1 0	Open Open

Table 9-1: Tester checkpoints in the primary diode (D1)

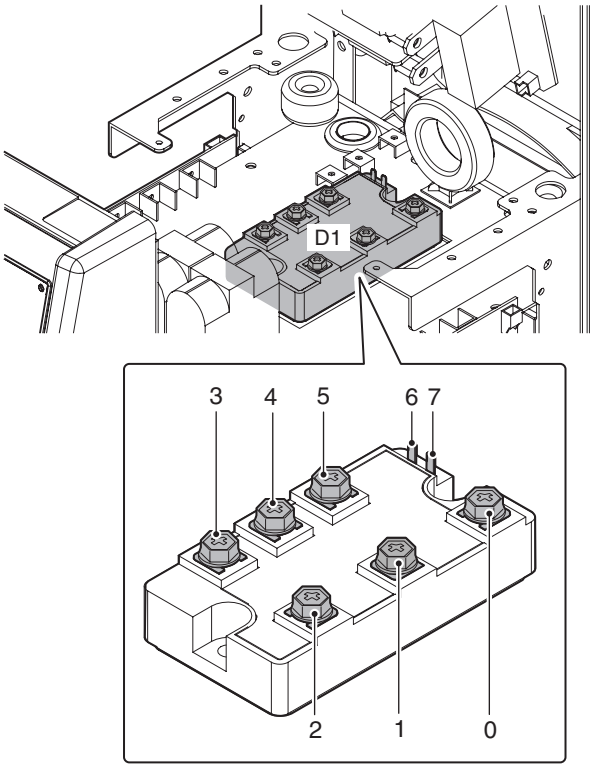


Figure 9-7: Tester checkpoints in the primary diode (D1)

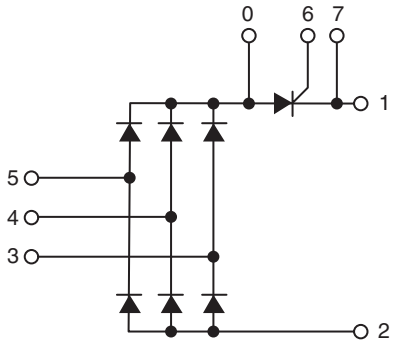


Figure 9-8: The primary diode (D1) interconnection diagrams

1.4.6 Verification of the secondary Diode (D2-5)

CAUTION

Before performing any portion of the procedure below, make certain the unit is placed in the initial set up condition as described in section 9.1.4.1 "Preparation".

1. Verify the characteristic of the secondary diode, D2, D3, D4, and D5 using a diode tester.
2. Refer to Table 9-2 and Figure 11 for the checkpoints on D2, D3, D4, and D5.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Diode 1 of D2, D3, D4, D5	Anode Cathode	Cathode Anode	0.2 to 0.3V Open
Diode 2 of D2, D3, D4, D5	Anode Cathode	Cathode Anode	0.2 to 0.3V Open

Table 9-2: Tester checkpoints in the secondary diode (D2, D3, D4, D5)

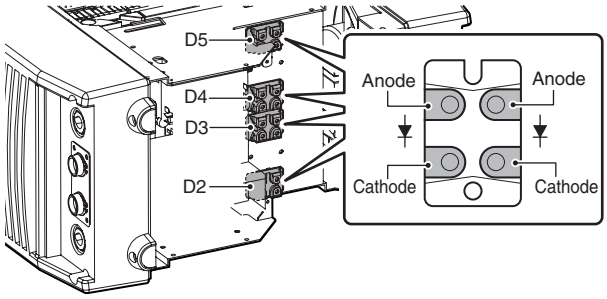


Figure 9-9: Tester checkpoints in the secondary diode (D2-7)

1.4.7 Verification of the primary IGBT (Q1-24)

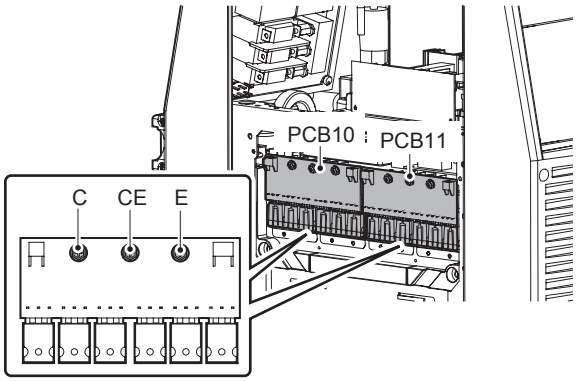
CAUTION

Before performing any portion of the procedure below, make certain the unit is placed in the initial set up condition as described in section 9.1.4.1 "Preparation".

1. Check whether there are any abnormalities on the appearance of PCB8 and PCB9.
2. Verify the characteristic of the primary IGBT (Q1-24), using a diode tester.
3. Refer to Table 9-3 and Figure 9-10 for the checkpoints on PCB8 and PCB9.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Collector-Emitter of Q1-24 with PCB8 and PCB9	C CE	CE C	Open 0.2 to 0.5V
Collector-Emitter of Q1-24 with PCB8 and PCB9	CE E	E CE	Open 0.2 to 0.5V

Table 9-3: Tester checkpoints in the primary IGBT



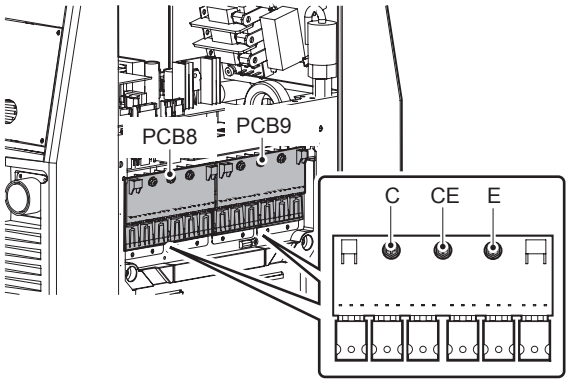


Figure 9-10: Tester checkpoints in the primary IGBT (Q1-24)

1.4.8 Verification of No-load Voltage (OCV)

a) Verify the no-load voltage in STICK mode.

1) STICK welding mode, mark and then turn potentiometer VR1 on PCB6 (WK-5688) fully counter clockwise to turn off the electric shock protector function (Voltage-Reduction-Device, VRD).
2) Contactor function is put into the state of "ON" by pushing the Function button.

CAUTION

Electric shock hazard. The unit will generate OCV immediately when contactor function is put into the state of " ON" pushing Function button enabling STICK mode.

3) Verify the no-load voltage using a DC voltmeter. (The capability of the voltmeter should be more than 100VDC.)
4) The normal no-load voltage is approximately 65V.

b) Verify the no-load voltage in MIG mode.

1) Confirm a secure connection between CON1 of the 14-pin receptacle (or CON2 of the 19-pin receptacle) and the remote device.
2) Confirm a secure connection of the harness and the connections between CON1 (or CON2) and PCB17 (WK-5699) are all correct and there are no open circuits.
3) Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.
4) Contactor function is put into the state of on pushing Function button.

CAUTION

Electric shock hazard. The unit will generate OCV immediately when contactor function is put into the state of "ON" pushing Function button enabling MIG mode.

5) The normal no-load voltage is approximately 65V.
6) Return potentiometer VR1 to the original position.

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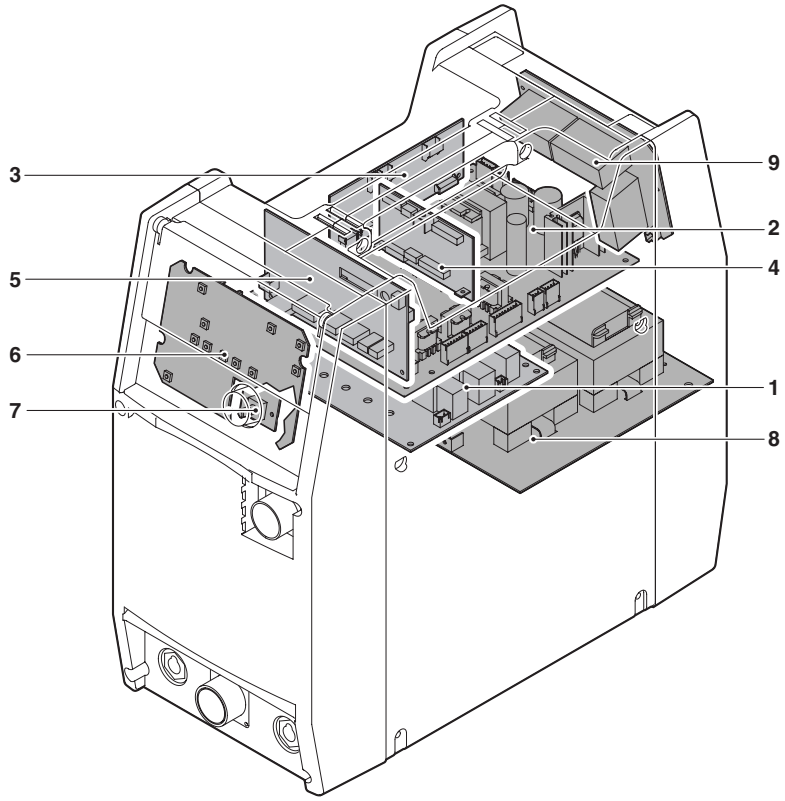
2 Subsystem Test and Replacement Procedures

2.1 Preparation

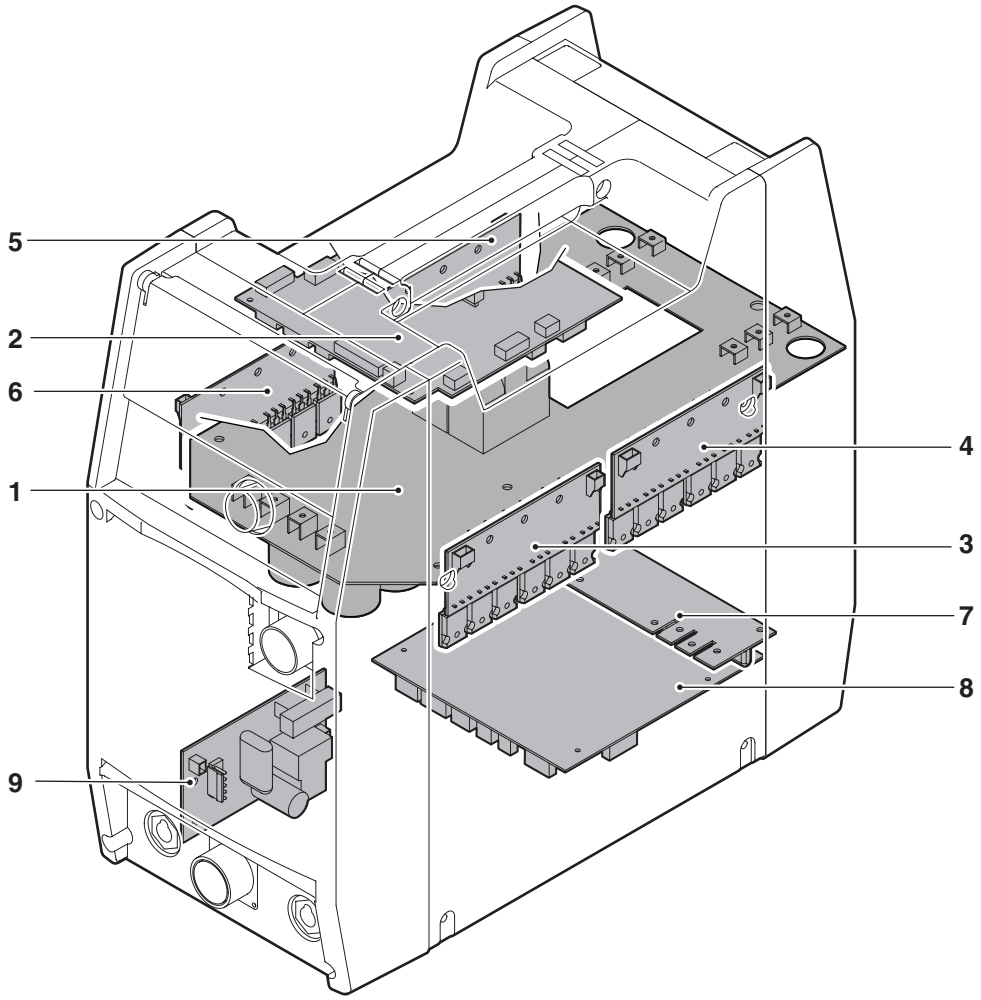
This section provides specific procedures for verifying the operation and replacement of each subsystem within the power supply.

Before undertaking any of these procedures, eliminate the obvious first-visually inspect the suspect subsystem for physical damage, overheating, and loose connections.

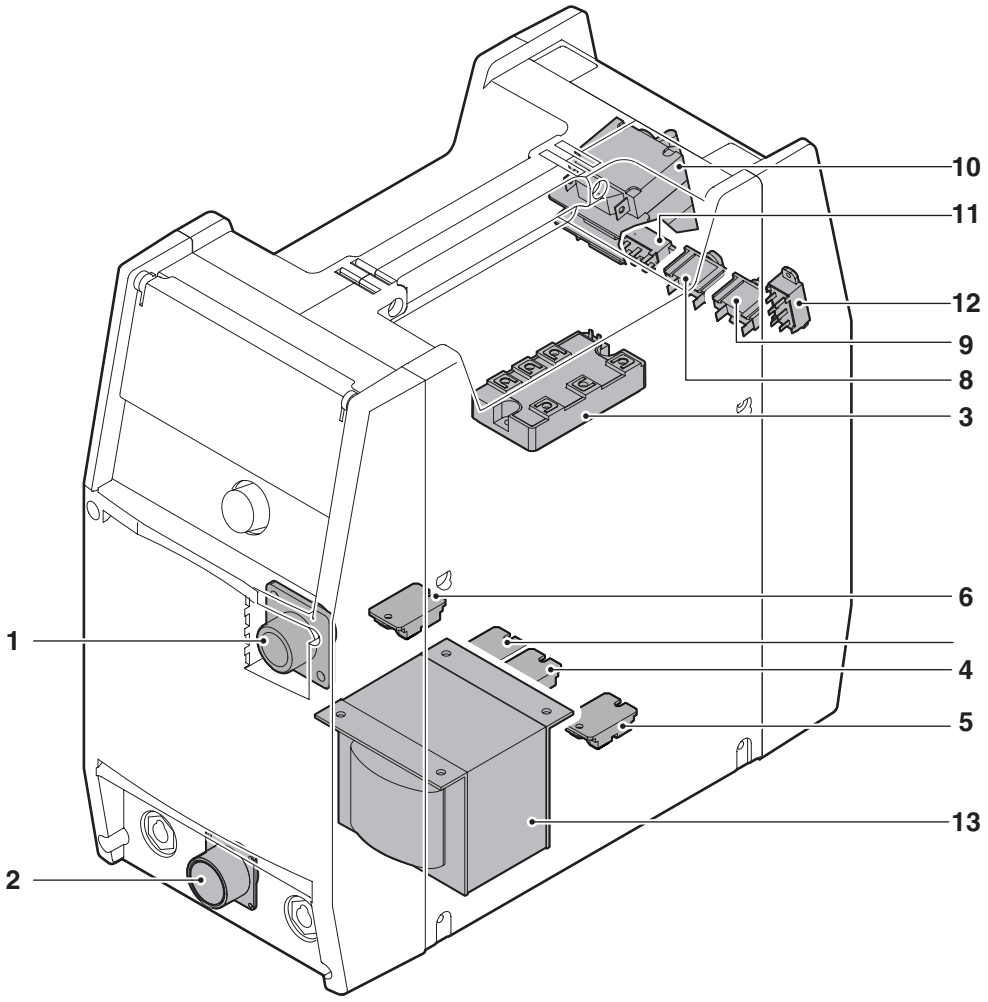
2.2 Test and Replacement Parts List



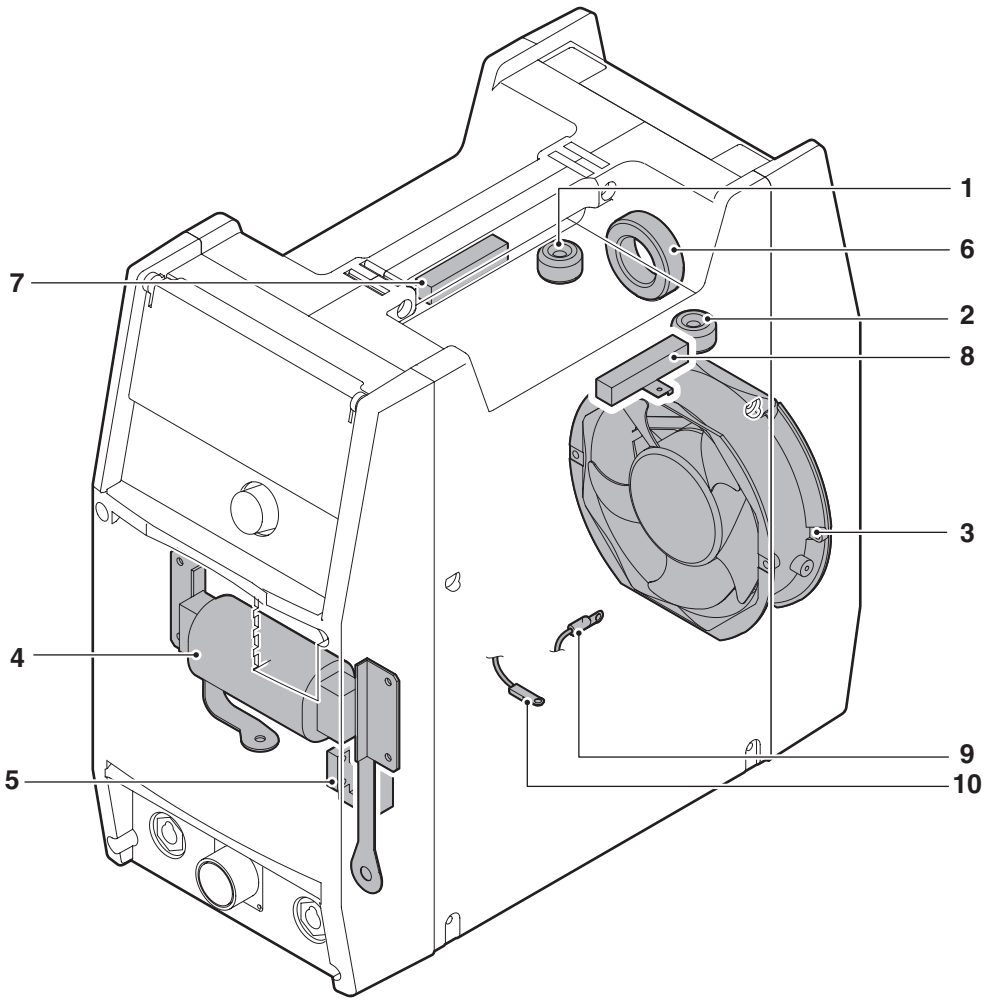
No.	DWG No.	Parts name	Reference page	Part No.
1	PCB2	Print Circuit Board (WK-5597)	9-23	W7001313
2	PCB3	Print Circuit Board (WK-5548)	9-24	W7001314
3	PCB4	Print Circuit Board (WK-4819)	9-26	10-6635
4	PCB5	Print Circuit Board (WK-5696)	9-26	W7001315
5	PCB7	Print Circuit Board (WK-5689)	9-24	W7001317
6	PCB12	Print Circuit Board (WK-5527)	9-28	W7001319
7	PCB13	Print Circuit Board (WK-5528)	9-29	W7001320
8	PCB14	Print Circuit Board (WK-5594)	9-30	W7001321
9	PCB16	Print Circuit Board (WK-4917)	9-32	10-6740



No.	DWG No.	Parts name	Reference page	Part No.
1	PCB1	Print Circuit Board (WK-5493)	9-22	W7001312
2	PCB6	Print Circuit Board (WK-5688)	9-27	W7001742
3	PCB8 (Q1-Q6)	Print Circuit Board (WK-5479)	9-27	W7001318
4	PCB9 (Q7-Q12)	Print Circuit Board (WK-5479)	9-27	W7001318
5	PCB10 (Q13-Q18)	Print Circuit Board (WK-5479)	9-28	W7001318
6	PCB11 (Q19-Q24)	Print Circuit Board (WK-5479)	9-28	W7001318
7	PCB15	Print Circuit Board (WK-5606)	9-31	W7001322
8	PCB17	Print Circuit Board (WK-5699)	9-33	W7001323
9	PCB18	Print Circuit Board (WK-5499)	9-33	W7001324



No.	DWG No.	Parts name	Reference page	Part No.
1	CON1	14-PIN Receptacle	9-47	W7001302
2	CON2	19-PIN Receptacle	9-48	W7001303
3	D1	Diode	9-39	10-6769
4	D2	Diode	9-40	10-6629
5	D4	Diode	9-40	10-6629
6	D5	Diode	9-40	10-6629
8	MCB1	Circuit Breaker	9-42	W7001310
9	MCB2	Circuit Breaker	9-42	10-2235
10	S1	Switch	9-37	10-6857
11	S2	Switch	9-38	10-5222
12	S3	Switch	9-38	10-5222
13	T1	Transformer	9-44	W7001326

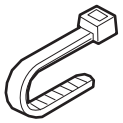
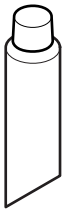


No.	DWG No.	Parts name	Reference page	Part No.
1	CT2	Current Trans	9-41	W7001304
2	CT3	Current Trans	9-41	W7001304
3	FAN1	Cooling Fan	9-36	W7001307
4	FCH1	Inductor	9-34	W7001308
5	HCT1	Current Sensor	9-39	10-5003
6	L1	Reactor	9-41	W7001309
7	R2	Resistor	9-43	W7001325
8	R3	Resistor	9-43	W7001325
9	TH1	Thermistor	9-35	10-5228
10	TH2	Thermistor	9-36	10-5228

2.3 Service Tools

2.3.1 Tools and parts

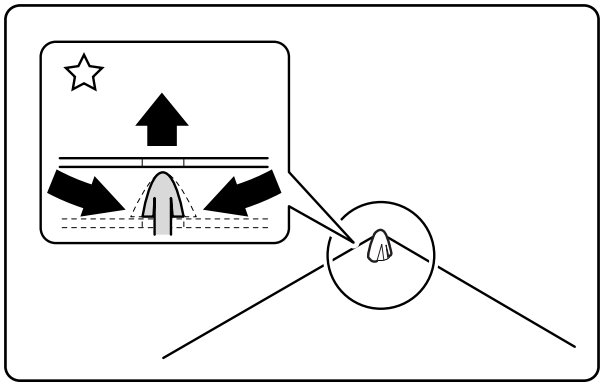
The tools and parts to be used for maintenance are shown by icons.

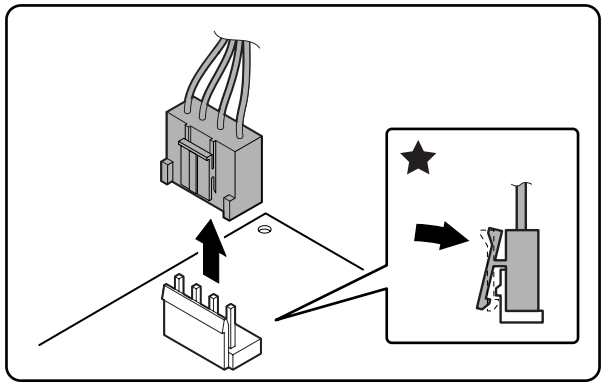
Spanner (5.5, 8, 10, 17mm)	Philips Head Screwdriver	Long Nose Pliers	C-Ring Pliers	Snap Band	Silicon Compound
					

2.3.2 Notes of disassembly and assembly

NOTE

When removing the locking type connectors and board supporters, disengage the locking mechanism first and then disconnect them.
Locking type connectors and board supporters are indicated in this manual using the following symbols; black star marks for locking connectors and white star marks for locking board supports.





NOTE

During your maintenance or repair, please cut any tie-wraps necessary. However, after your maintenance or repair, please reassemble and tie-wrap all components and wiring in the same manner as before the maintenance or repair.

CAUTION

Please note that you remove each connector, grasp and pull out by the connector part only. Do not pull the harness (cable) part.

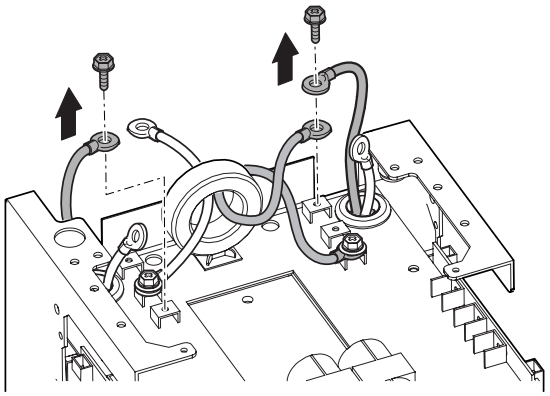
WARNING

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete.

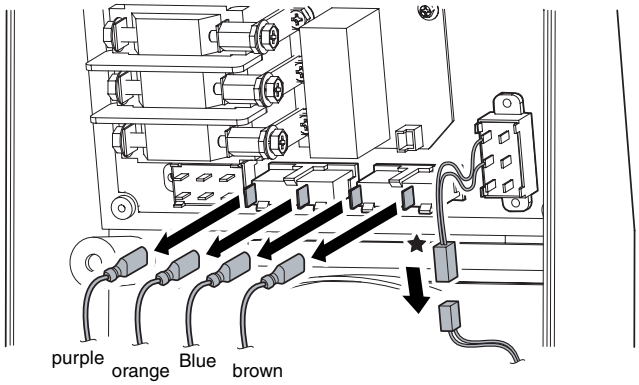
2.4 Replacement Procedure

2.4.1 PCB1 (WK-5493)

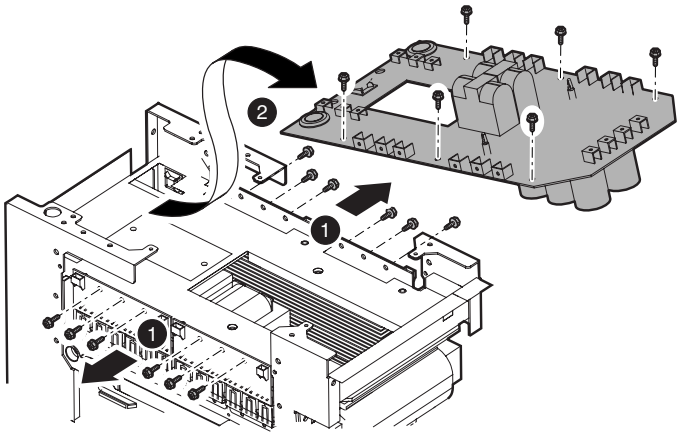
1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB2 (WK-5597). [Reference page: 9-23]
3) Remove the diode (D1). [Reference page: 9-39]
4) Remove the current transformers (CT2 and CT3). [Reference page: 9-41]
5) Remove two screws and three terminals from PCB1 (WK-5493).



6) Remove the reactor (L1). [Reference page: 9-41]
7) Disconnect one connector and remove four terminals.

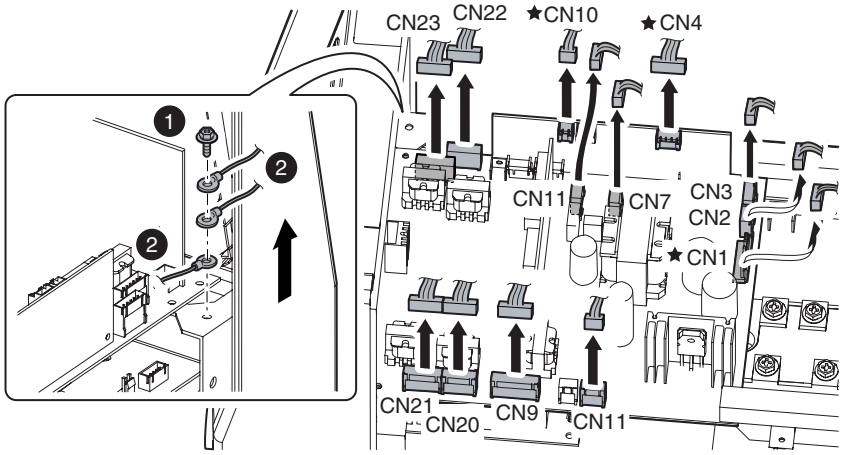


8) Remove 18 screws and remove PCB1 (WK-5493).

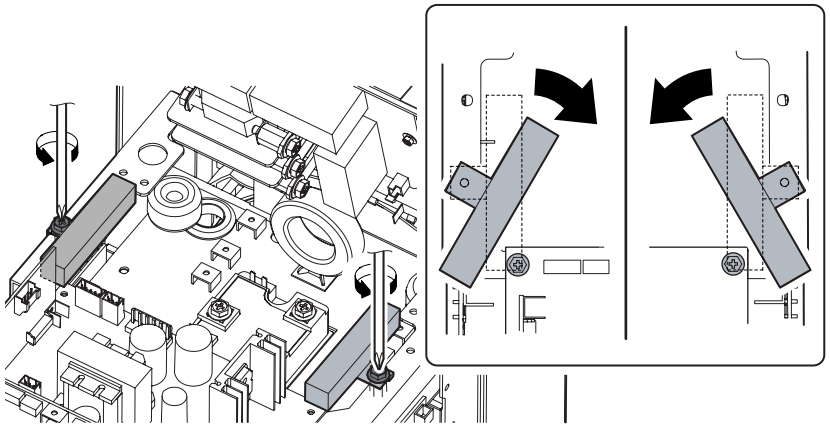


2.4.2 PCB2 (WK-5597)

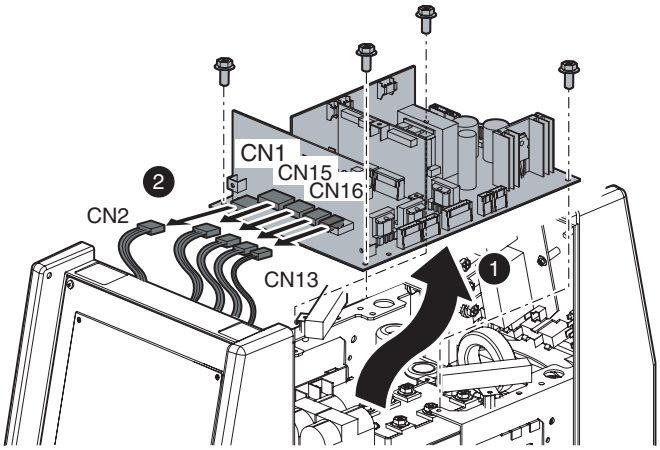
1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB6 (WK-5688). [Reference page: 9-27]
3) Remove one screw and three ground terminals. Disconnect 13 connectors.



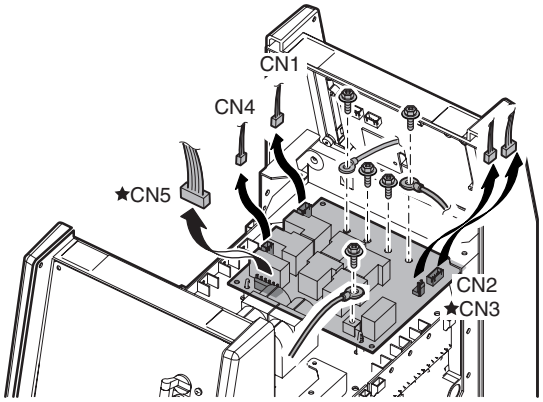
4) Loosen two screws. Rotate the resistors (R2 and R3) to expose two screws on PCB3 (WK-5548).



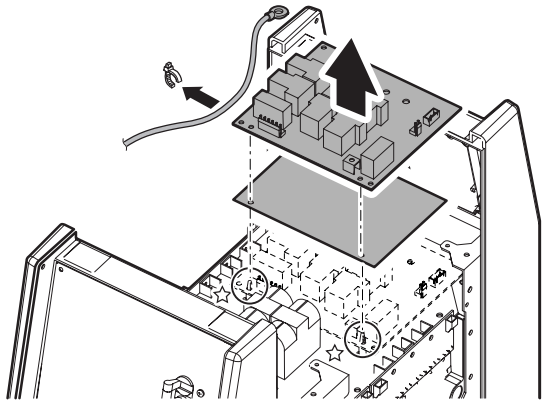
5) Disconnect five connectors.



6) Remove five screws, three terminals, and five connectors from PCB2 (WK-5597).

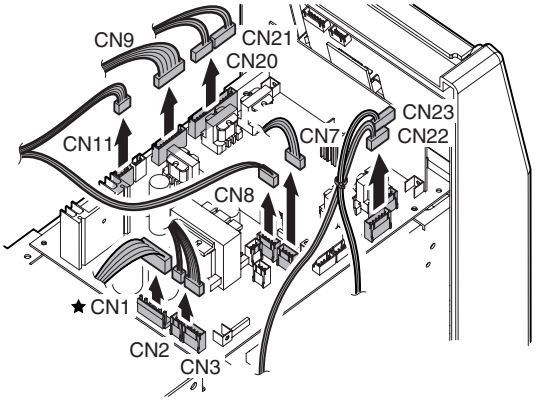


7) Cut off one snap band. Remove two board supports and then remove PCB2 (WK-5597) and the insulating sheet.

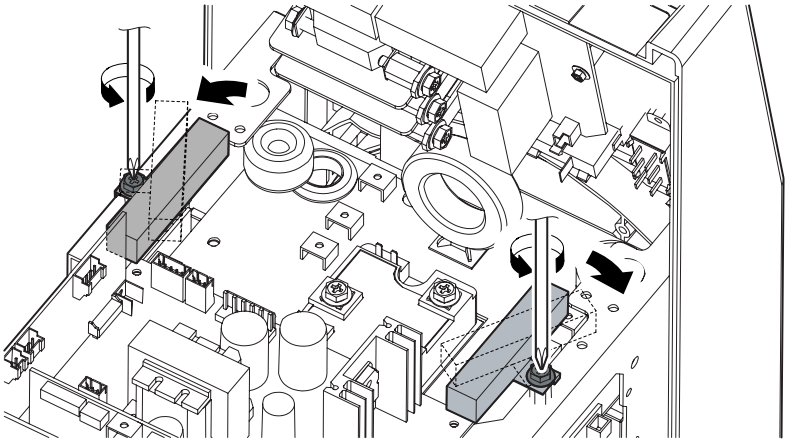


2.4.3 PCB3 (WK-5548), PCB7 (WK-5689)

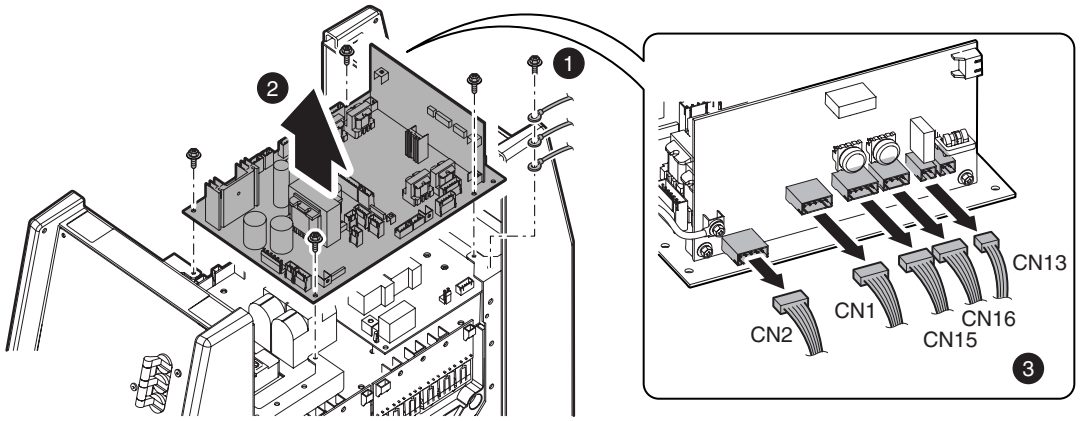
1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB4 (WK-4819). [Reference page: 9-26]
3) Remove PCB6 (WK-5688). [Reference page: 9-27]
4) Remove PCB5 (WK-5696). [Reference page: 9-26]
5) Disconnect 11 connectors from PCB3 (WK-5548).



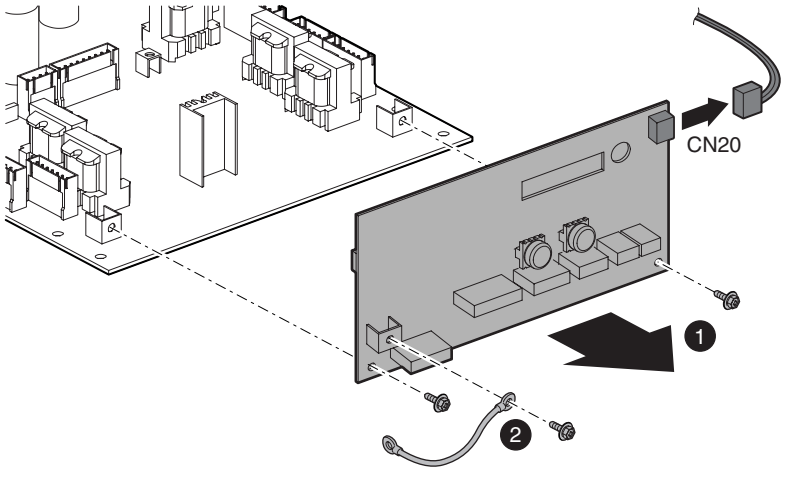
6) Loosen two screws. Rotate the resistors (R2 and R3) to expose two screws on PCB3 (WK-5548).



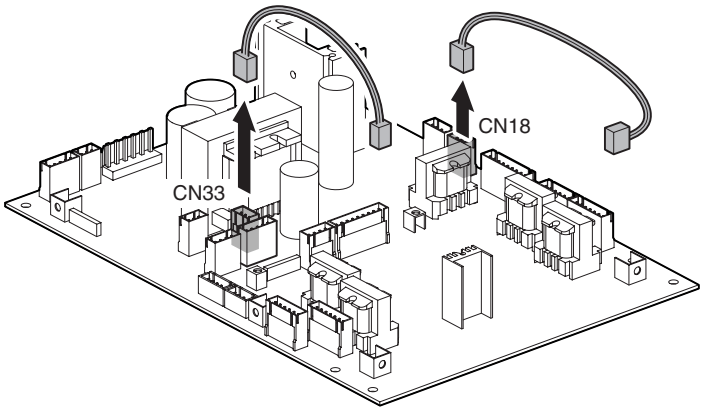
7) Remove one screw and three ground terminals. Remove four screws and remove PCB3 and PCB7. Disconnect five connectors from PCB7 (WK-5689).



8) Disconnect one connector and remove two screws and then remove PCB7 (WK-5689) from PCB3 (WK-5548). Remove one screw and one ground terminal from PCB7 (WK-5689).

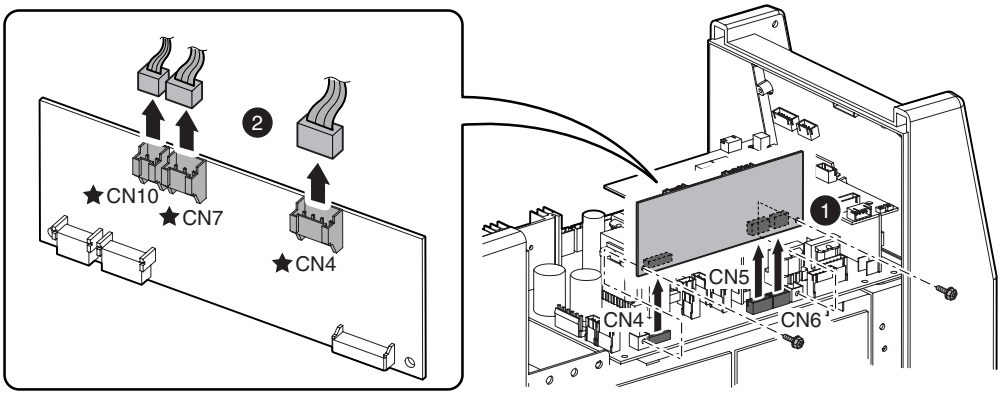


9) Disconnect two connectors from PCB3 (WK-5548).



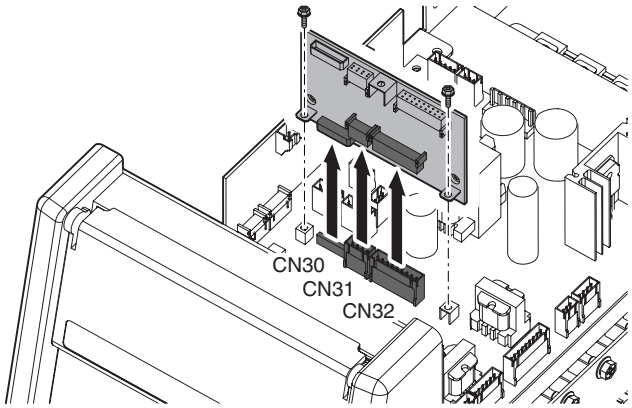
2.4.4 PCB4 (WK-4819)

1) Remove the side cover. [Reference page: 9-1]
2) Disconnect three connectors. Remove two screws and disconnect three connectors, and then remove PCB4 (WK-4819).



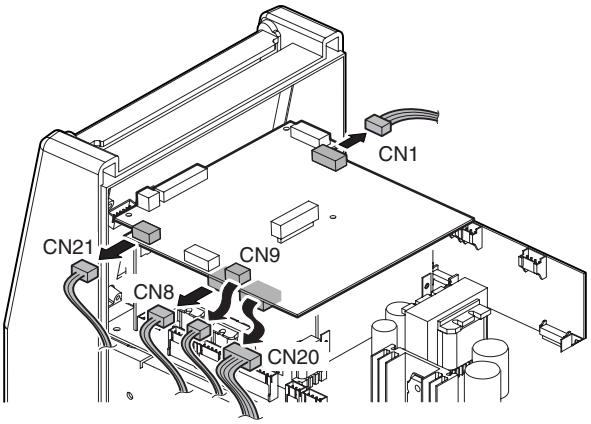
2.4.5 PCB5 (WK-5696)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB6 (WK-5688). [Reference page: 9-27]
3) Remove two screws and disconnect three connectors. Remove PCB5 (WK-5696).

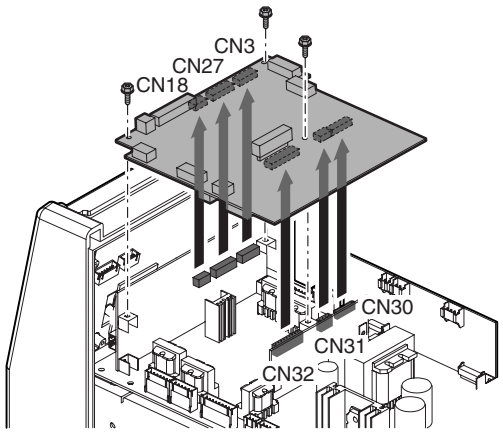


2.4.6 PCB6 (WK-5688)

1) Remove the side cover. [Reference page: 9-1]
2) Disconnect five connectors.

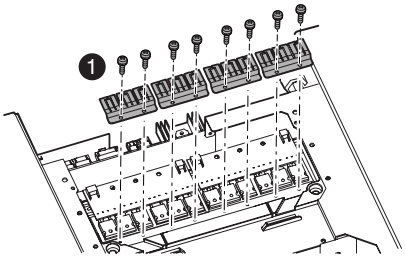


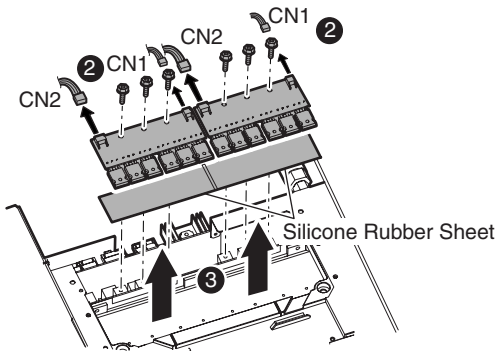
3) Remove three screws and disconnect six connectors, and then remove PCB6 (WK-5688).



2.4.7 PCB8 (WK-5479) and PCB9 (WK-5479)

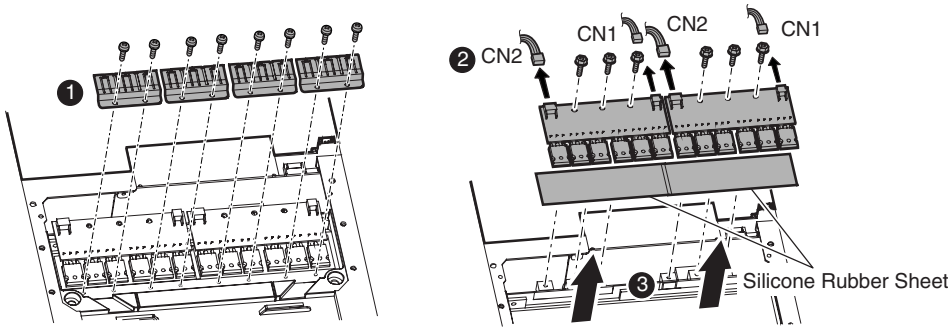
1) Remove the side cover. [Reference page: 9-1]
2) Remove eight screws and four component clips. Disconnect four connectors and remove six screws, and then remove PCB8 (WK-5479) and PCB9 (WK-5479).
   • When reinstalling, remember to install new silicon rubber sheets.





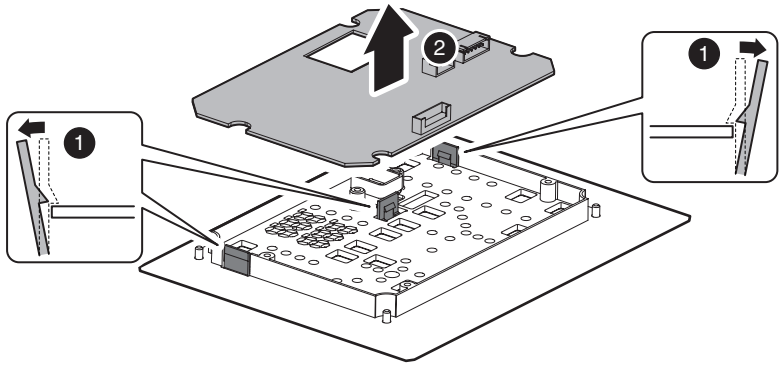
2.4.8 PCB10 (WK-5479), PCB11 (WK-5479)

1) Remove the side cover. [Reference page: 9-1]
2) Remove eight screws and four component clips. Disconnect four connectors and remove six screws, and then remove PCB10 (WK-5479) and PCB11 (WK-5479).
   • When reinstalling, remember to install new silicon rubber sheets.

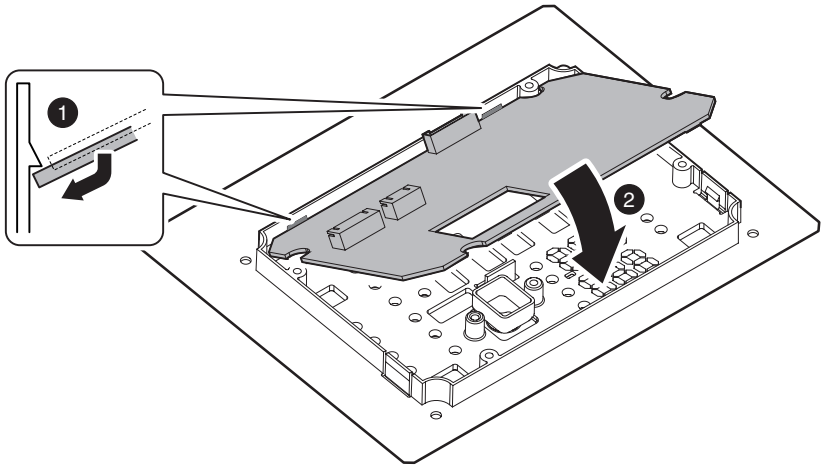


2.4.9 PCB12 (WK-5527)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB13 (WK-5528). [Reference page: 9-29]
3) Release three hooks and remove PCB12 (WK-5527).

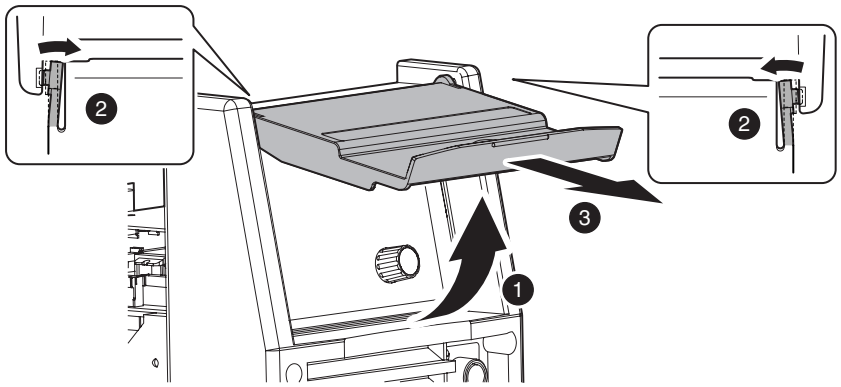


• Engage two hooks before reinstalling the unit.

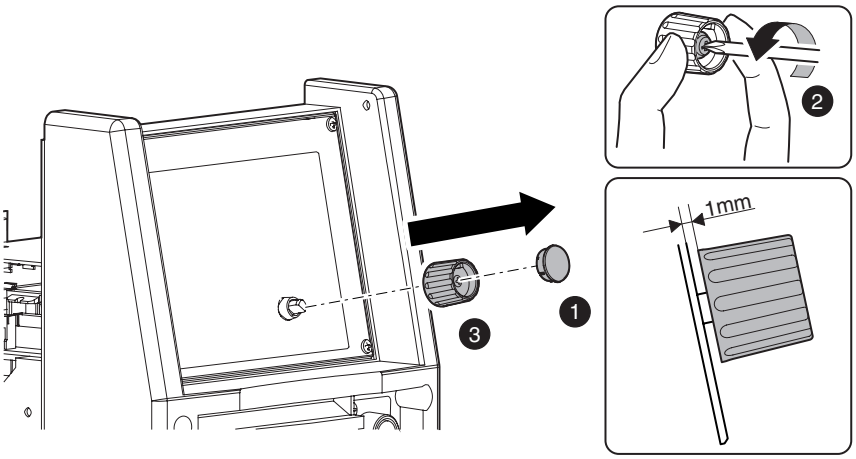


2.4.10 PCB13 (WK-5528)

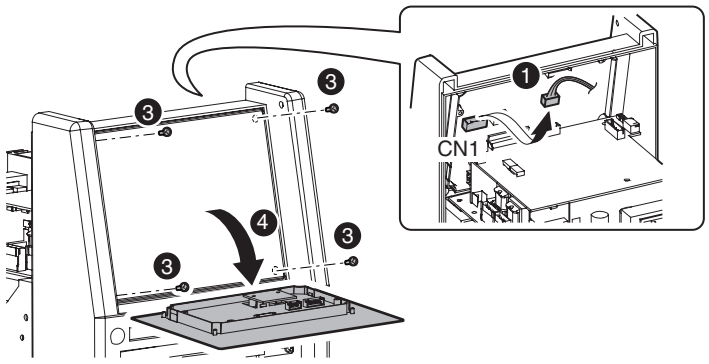
1) Remove the side cover. [Reference page: 9-1]
2) Remove the operation cover.



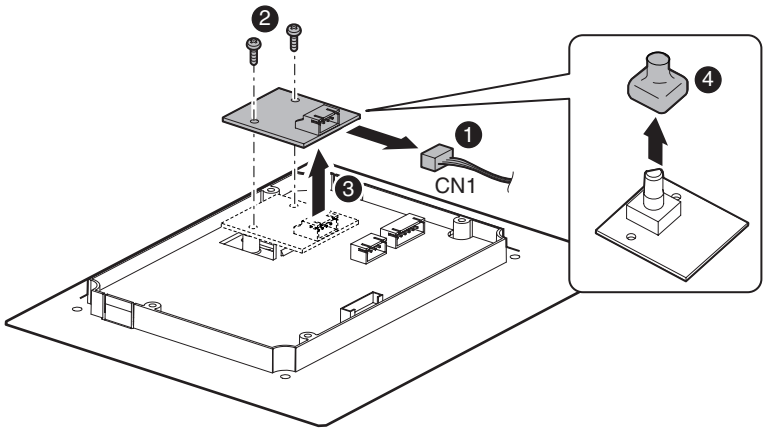
3) Remove the jog dial cap. Loosen the screw while pressing the jog dial and then remove the jog dial.



4) Disconnect one connector from PCB12 (WK-5527). Remove four screws and pull out the operation panel and tilt it.

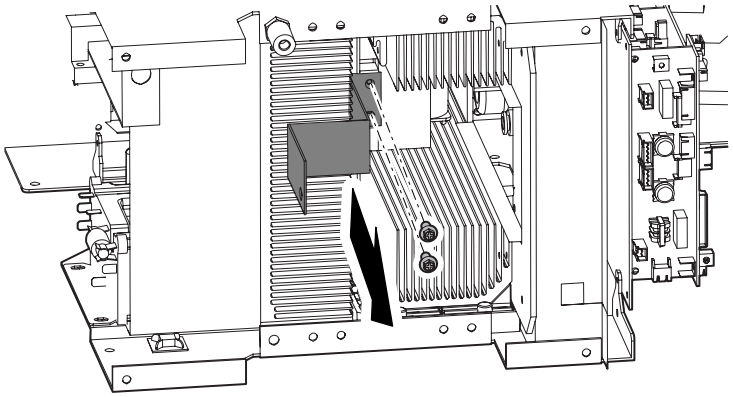


5) Disconnect one connector and remove two screws, and then remove PCB13 (WK-5528).

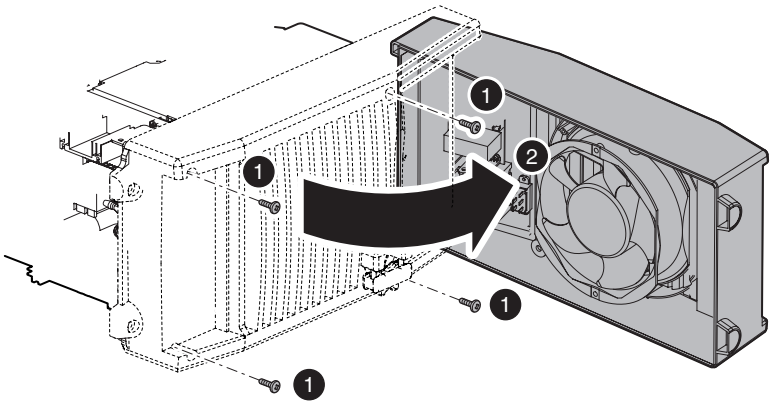


2.4.11 PCB14 (WK-5594)

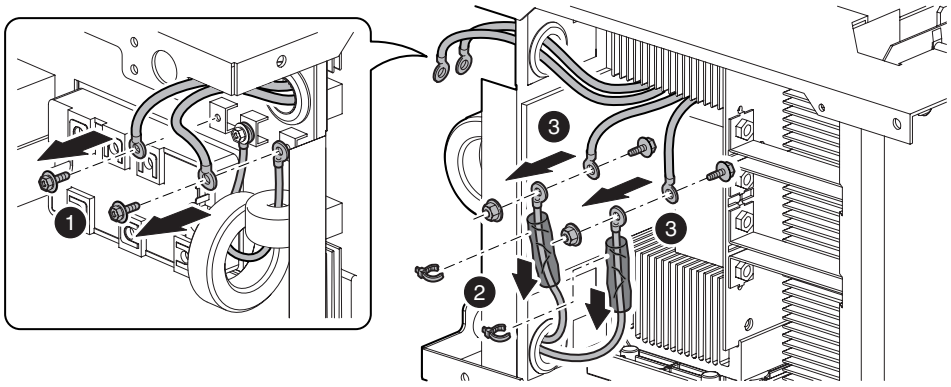
1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB17 (WK-5699). [Reference page: 9-33]
3) Remove the inductor (FCH1). [Reference page: 9-34]
4) Remove two screws from the front side and detach the bus bar.



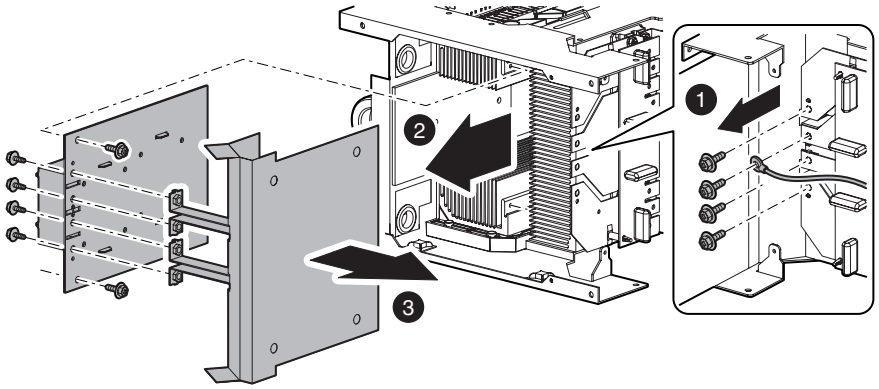
5) Remove four screws and open the rear cabinet.



6) Remove two screws from PCB1 (WK-5477) and disconnect three terminals. Cut off two snap bands and slide the insulating tube. Remove two screws, two nuts, and four terminals.

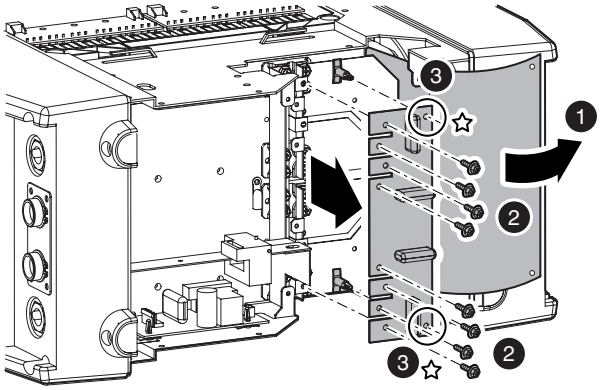


7) Remove four screws from the bottom and disconnect one terminal. Remove two screws from the rear side and remove PCB14 (WK-5594) by pulling it out. Remove four screws and detach the bus bar.



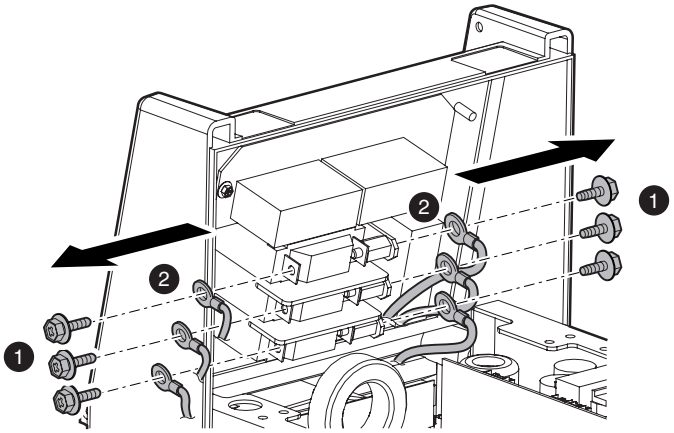
2.4.12 PCB15 (WK-5606)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB17 (WK-5699). [Reference page: 9-33]
3) Remove the sheet and remove eight screws. Remove two board supports and remove PCB15 (WK-5606).

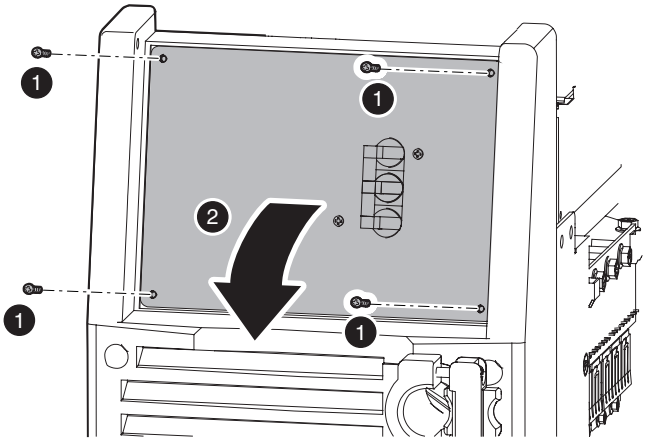


2.4.13 PCB16 (WK-4917)

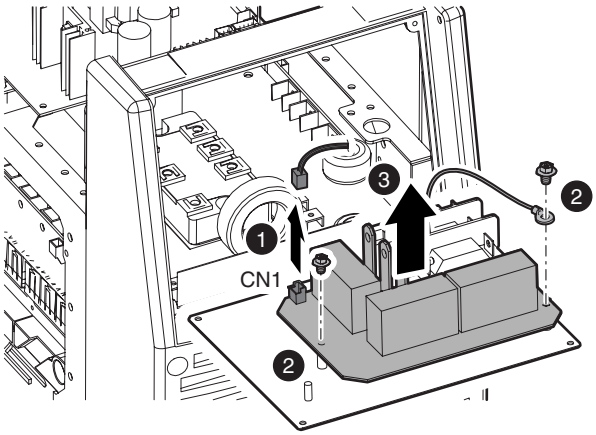
1) Remove the side cover. [Reference page: 9-1]
2) Remove six screws from the switch (S1) and disconnect six terminals.



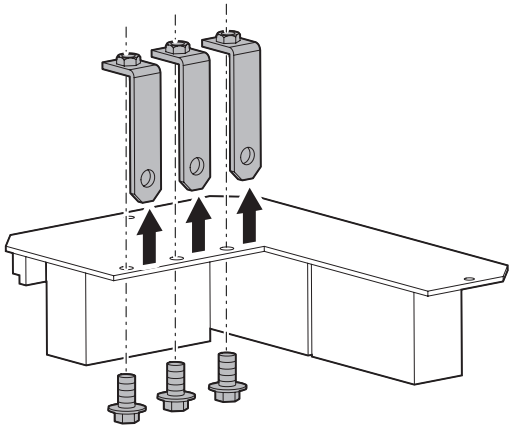
3) Remove four screws and open the rear board.



4) Disconnect the one connector. Remove the two screws and one ground terminal. Remove the PCB16 (WK-4917).

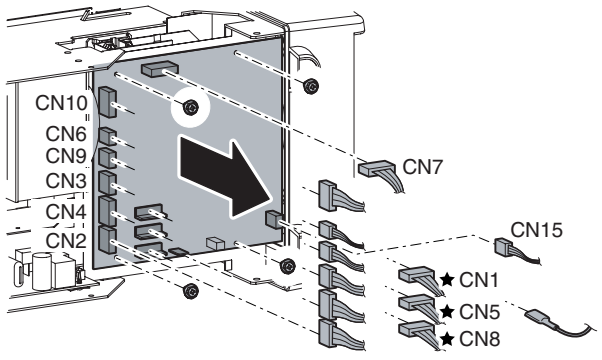


5) Remove the three screws and the bus bar from the PCB16 (WK-4917).



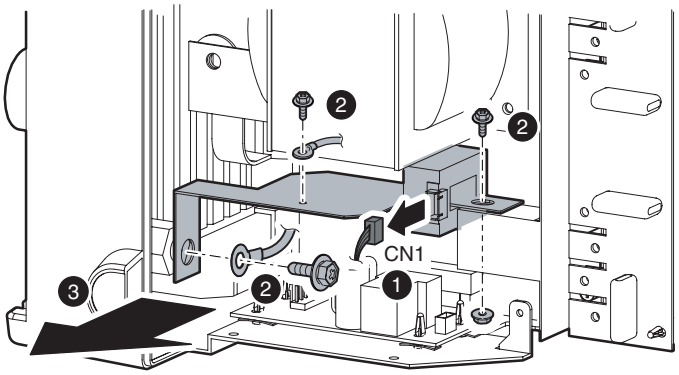
2.4.14 PCB17 (WK-5699)

1) Remove the side cover. [Reference page: 9-1]
2) Disconnect 11 connectors and remove one terminal. Remove four screws and remove PCB17 (WK-5699).

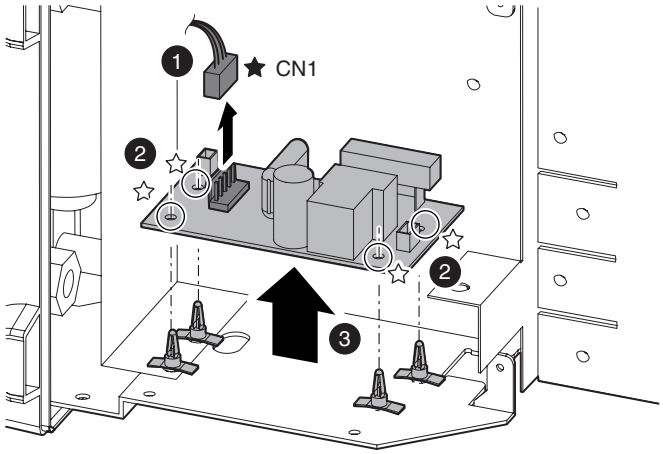


2.4.15 PCB18 (WK-5499)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB17 (WK-5699). [Reference page: 9-33]
3) Remove one screw and one terminal. Remove one bolt, one toothed washer, one washer, and one terminal. Disconnect one connector. Remove one screw and one nut and detach the bus bar.

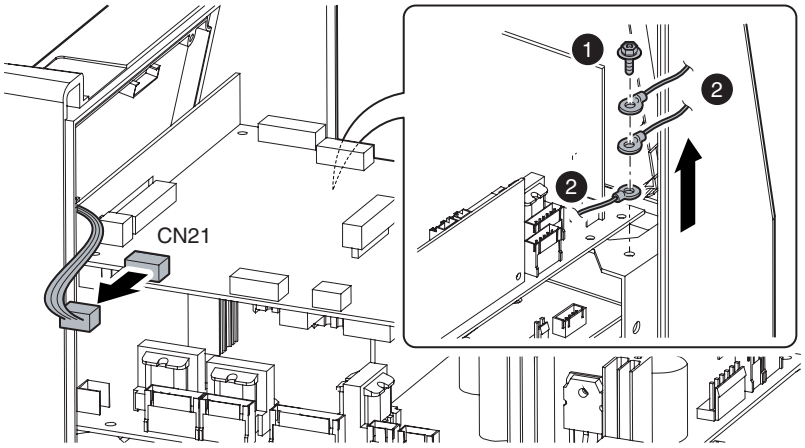


4) Disconnect two connectors. Remove four board supports and remove PCB18 (WK-5499).

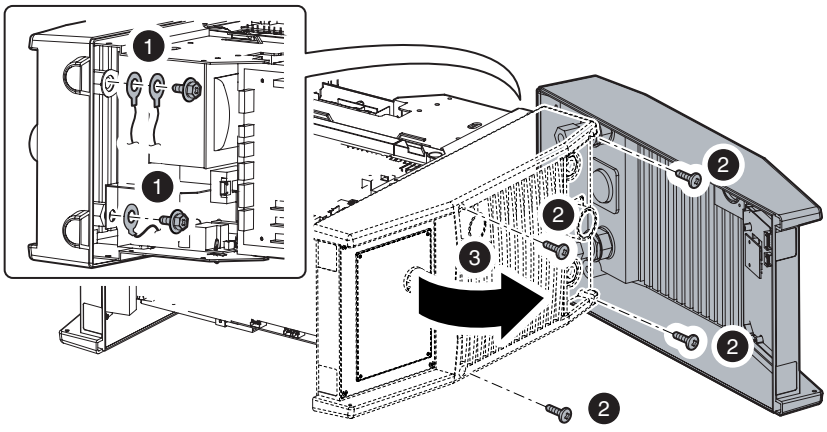


2.4.16 Inductor (FCH1)

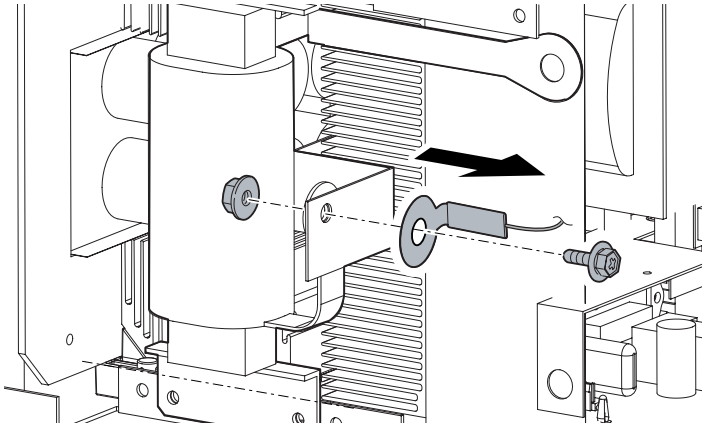
1) Remove the side cover. [Reference page: 9-1]
2) Disconnect one connector. Remove one screw and three ground terminals.



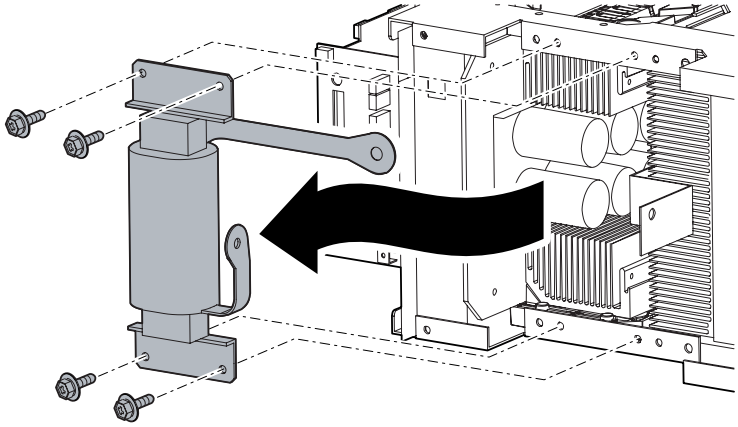
3) Remove two bolts and three terminals. Remove four screws and open the front cabinet.



4) Remove one screw, one terminal and one nut.

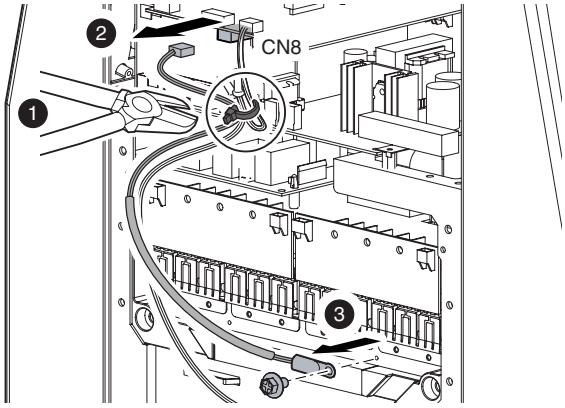


5) Remove four screws and remove the inductor (FCH1).



2.4.17 Thermistor (TH1)

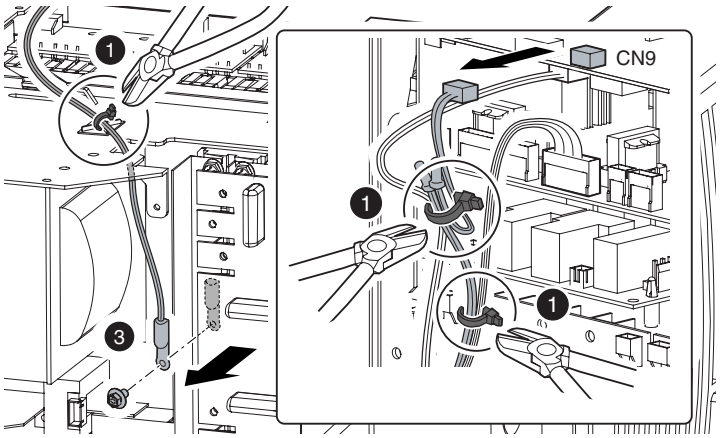
1) Remove the side cover. [Reference page: 9-1]
2) Cut off one snap band and disconnect one connector. Remove one screw and remove the thermistor (TH1).



- When replacing the thermistor with a new one, apply an oil compound (SHINETSU SILICONE G-747 or equivalent) evenly to the base.

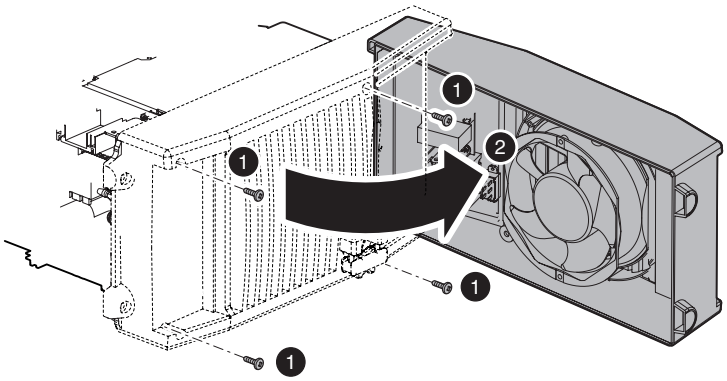
2.4.18 Thermistor (TH2)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB17 (WK-5699).
3) Cut off three snap bands and disconnect one connector. Remove one screw and remove the thermistor (TH2).
   • When replacing the thermistor with a new one, apply an oil compound (SHINETSU SILICONE G-747 or equivalent) evenly to the base.

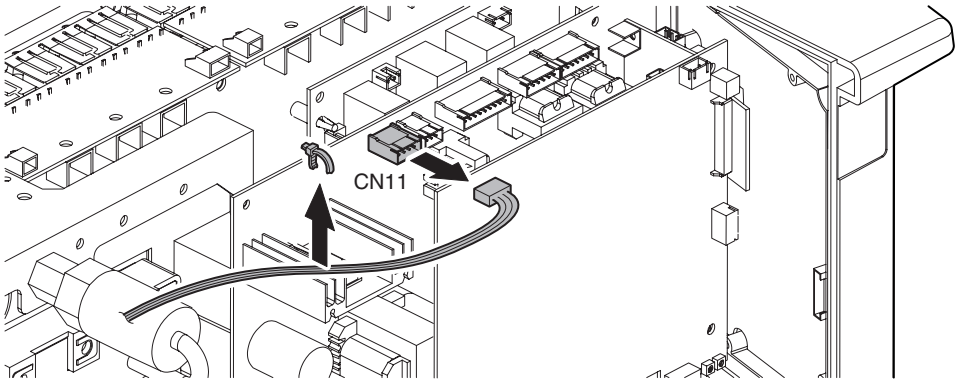


2.4.19 Fan (FAN1)

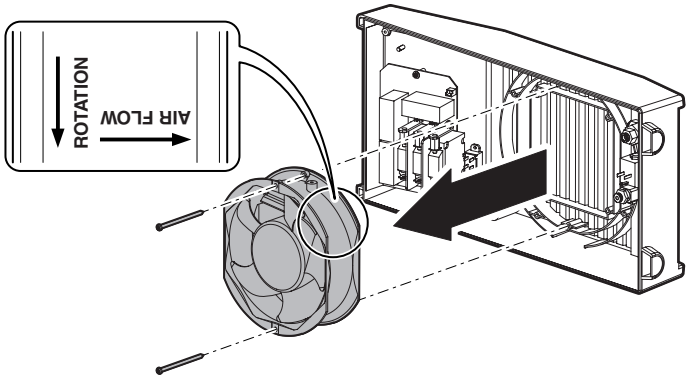
1) Remove the side cover. [Reference page: 9-1]
2) Remove four screws and open the rear cabinet.



3) Cut off one snap band and disconnect one connector.

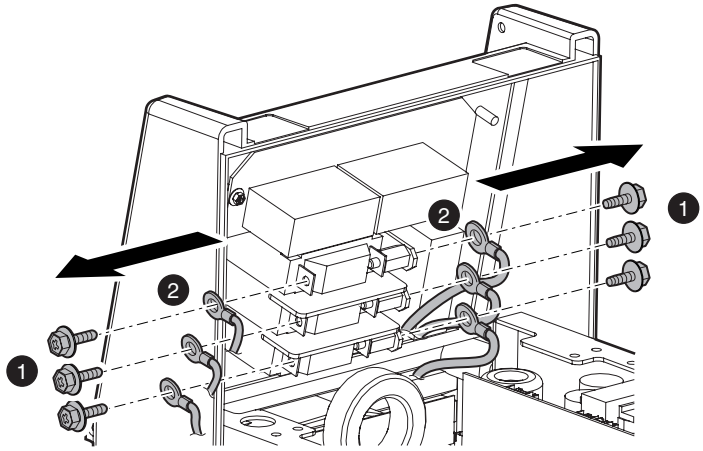


4) Remove two screws and remove the fan (FAN1).
   • Pay attention to the installation direction of the fan.

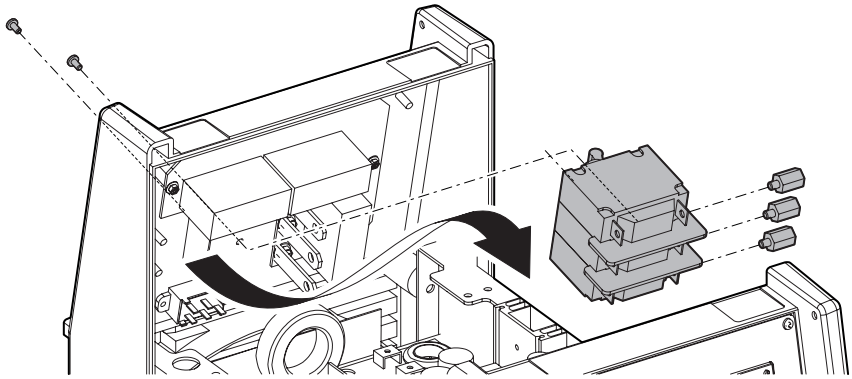


2.4.20 Switch (S1)

1) Remove the side cover. [Reference page: 9-1]
2) Remove six screws and six terminals.

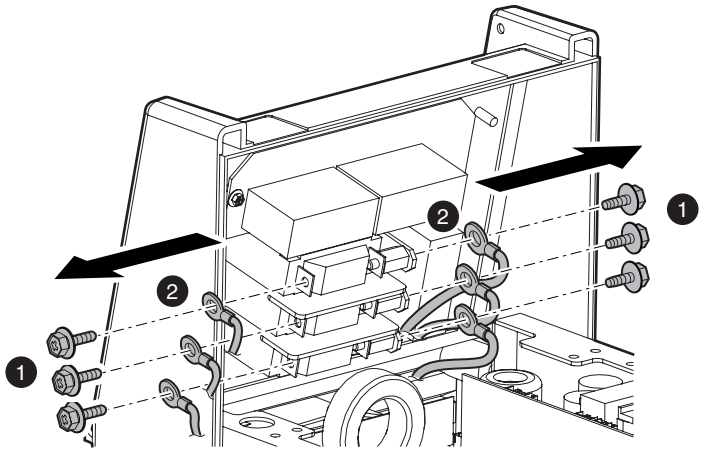


3) Remove two screws and remove the switch (S1). Remove three posts.

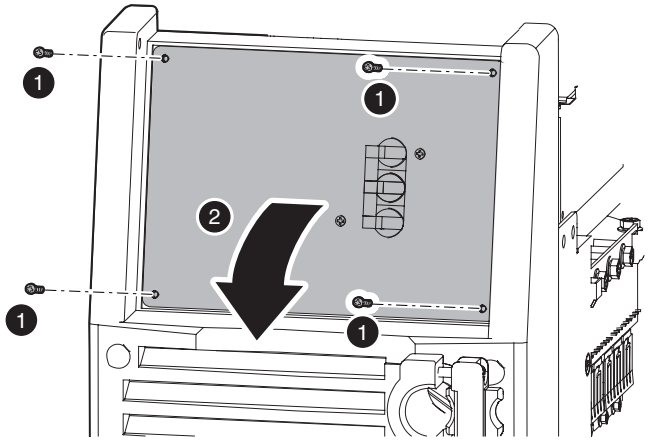


2.4.21 Switch (S2 and S3)

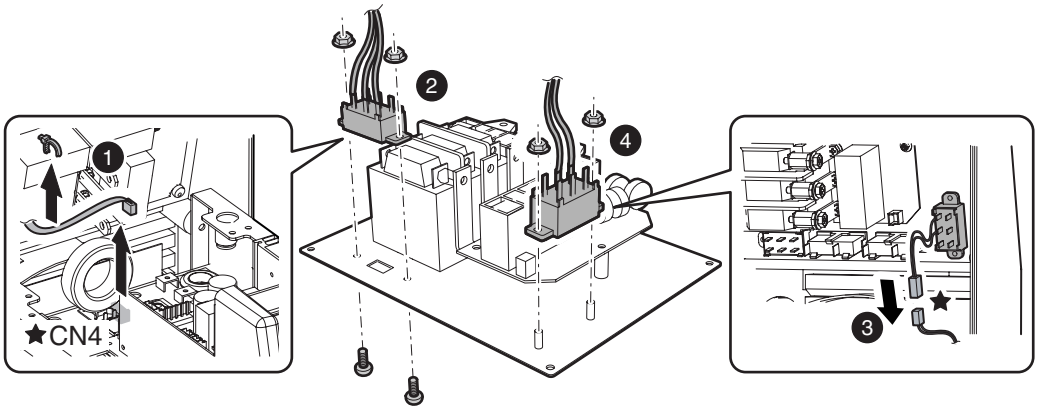
1) Remove the side cover. [Reference page: 9-1]
2) Remove six screws and six terminals.



3) Remove four screws and open the rear panel.

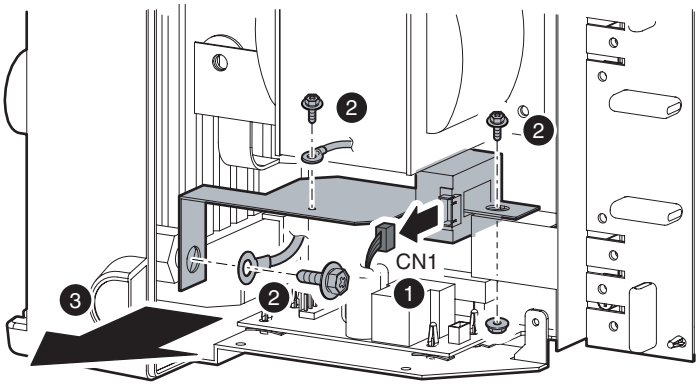


4) Cut off one snap band and disconnect one connector from PCB4 (WK-4819). Remove two screws and two nuts and remove the switch (S2). Disconnect one connector from the switch (S3). Remove two nuts and remove the switch (S3).

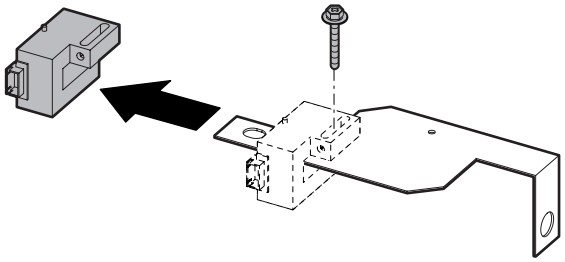


2.4.22 Current Sensor (HCT1)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB17 (WK-5699). [Reference page: 9-33]
3) Remove one screw and one terminal. Remove one bolt and one terminal. Disconnect one connector. Remove one screw and one nut and detach the bus bar.

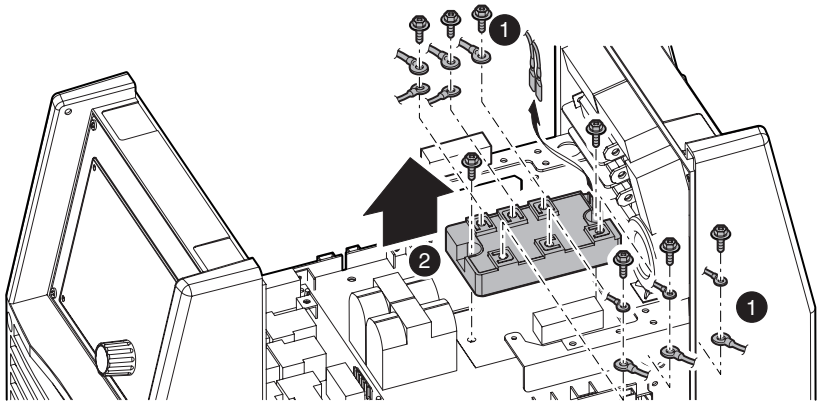


4) Remove one screw and remove the current sensor (HCT1).



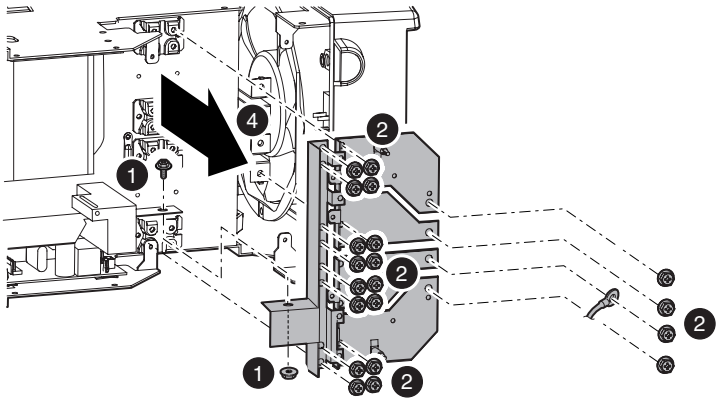
2.4.23 Diode (D1)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB3 (WK-5548). [Reference page: 9-24]
3) Remove six screws and 13 terminals. Remove two screws and remove the diode (D1).
   • When replacing the diode with a new one, apply an oil compound (SHINETSU SILICONE G-747 or equivalent) evenly to the base.

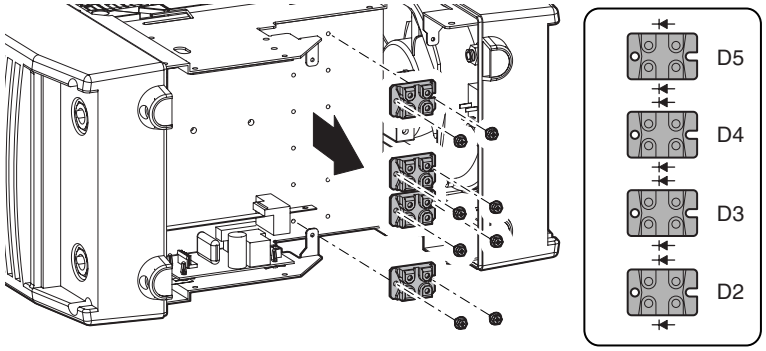


2.4.24 Diode (D2, D3, D4, and D5)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB17 (WK-5699). [Reference page: 9-33]
3) Remove PCB15 (WK-5606). [Reference page: 9-31]
4) Remove one screw and one nut. Remove 20 screws and one terminal and detach the bus bar.

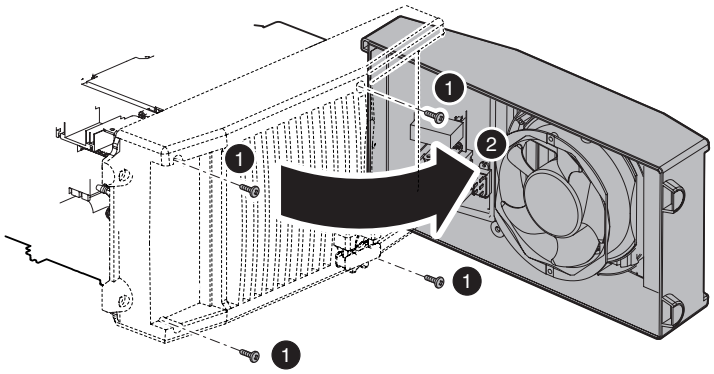


5) Remove eight screws and remove the diodes (D2, D3, D4, and D5).
   - When replacing the diode with a new one, apply an oil compound (SHINETSU SILICONE G-747 or equivalent) evenly to the base.
   - Pay attention to the installation direction of the diode.

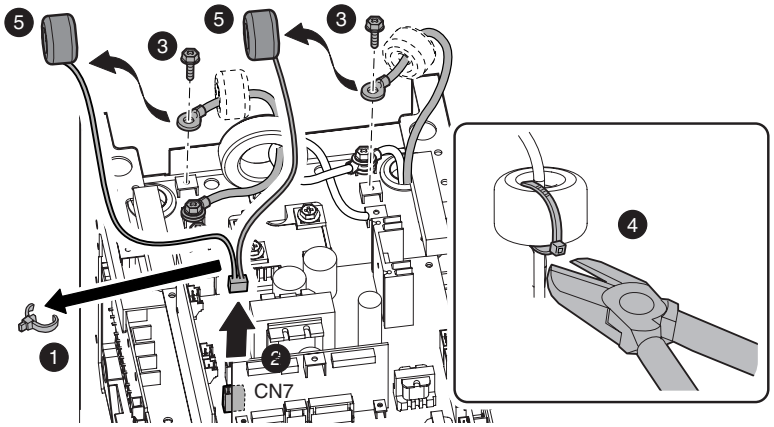


2.4.25 Current Transformer (CT2 and CT3)

1) Remove the side cover. [Reference page: 9-1]
2) Remove PCB6 (WK-5688). [Reference page: 9-27]
3) Remove four screws and open the rear cabinet.

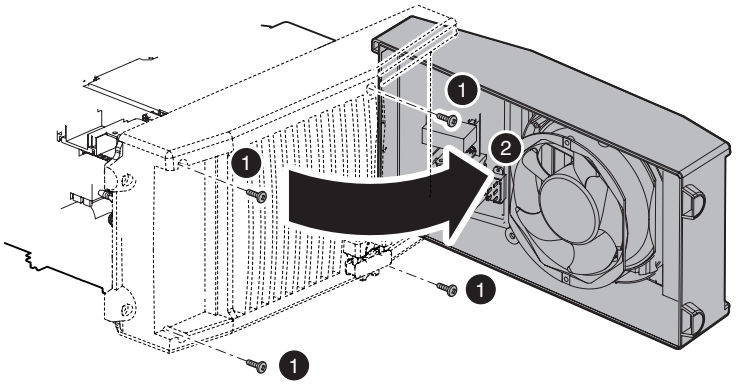


4) Cut off one snap band and disconnect one connector from PCB3 (WK-5548). Remove two screws and two terminals from PCB1 (WK-5493). Cut off two snap bands and remove the current transformers (CT2 and CT3).

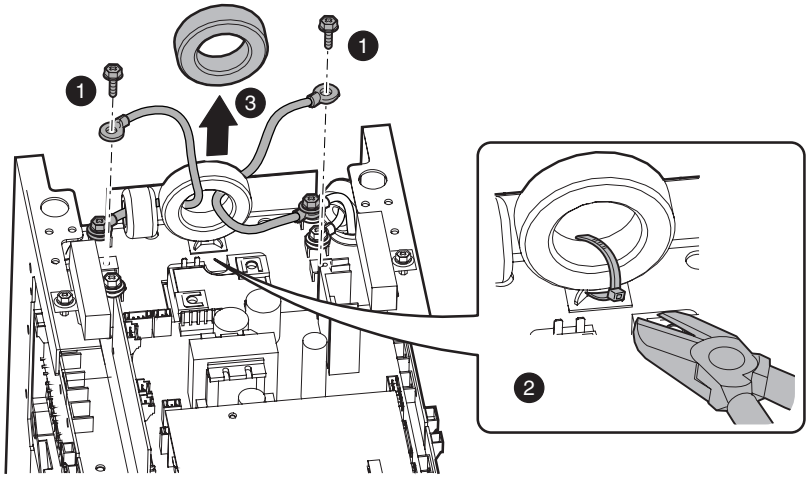


2.4.26 Reactor (L1)

1) Remove the side cover. [Reference page: 9-1]
2) Remove four screws and open the rear cabinet.

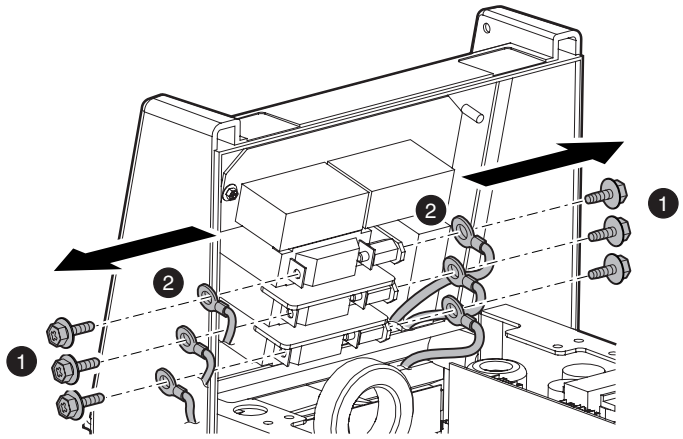


3) Remove two screws and two terminals. Cut off one snap band and remove the reactor (L1).

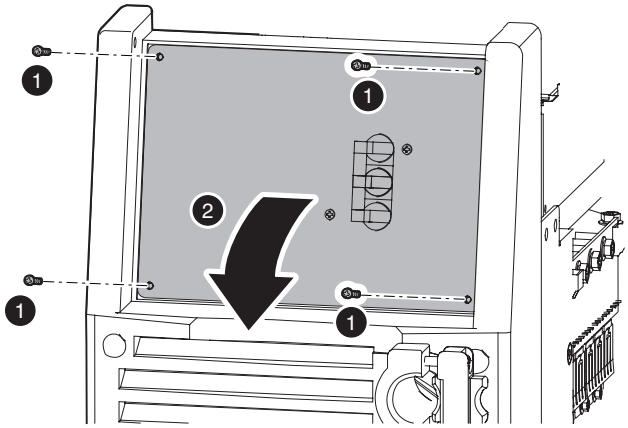


2.4.27 Molded Case Circuit Breader (MCB1 and MCB2)

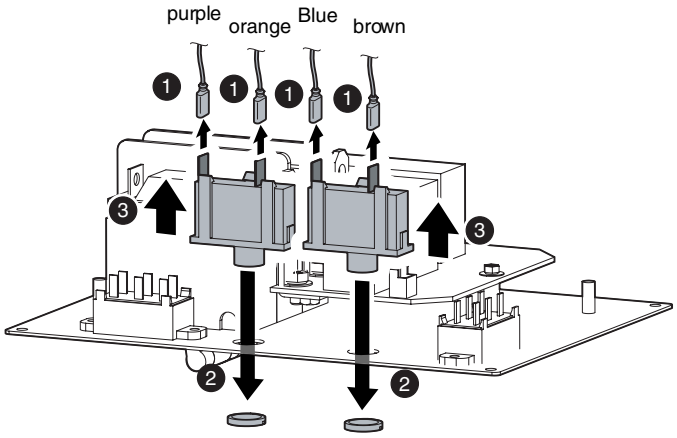
1) Remove the side cover. [Reference page: 9-1]
2) Remove six screws and six terminals.



3) Remove four screws and open the rear panel.

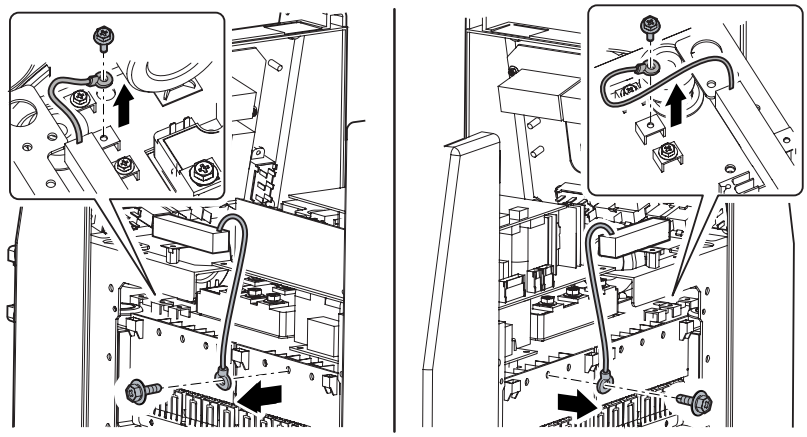


4) Remove four terminals. Remove two nuts and remove the molded case circuit breakers (MCB1 and MCB2).

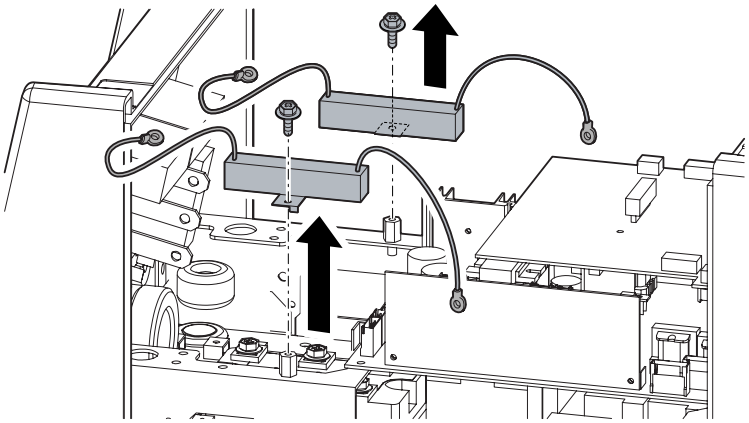


2.4.28 Resistor (R2 and R3)

1) Remove the side cover. [Reference page: 9-1]
2) Remove the switch (S1). [Reference page: 9-37]
3) Remove four screws and four terminals.

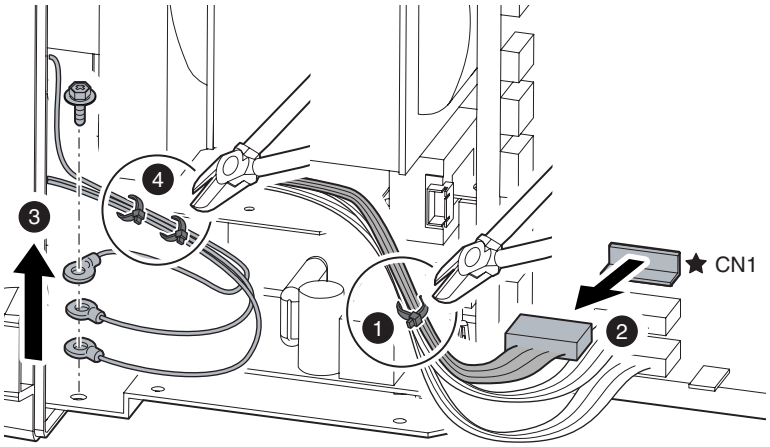


4) Remove two screws and the resistors (R2 and R3).

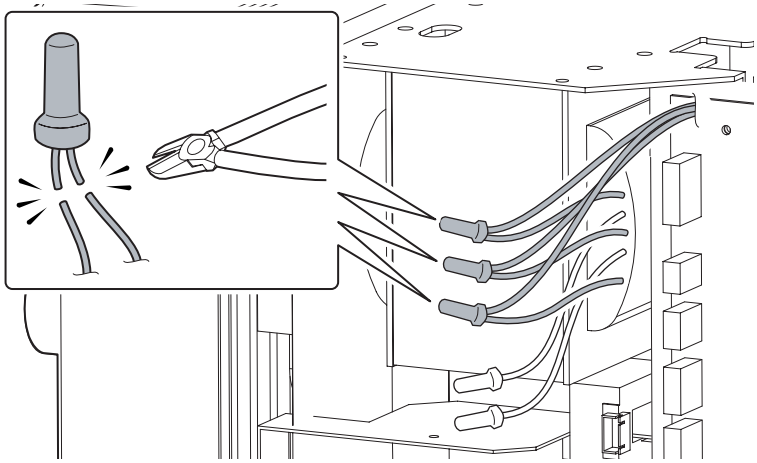


2.4.29 Transformer (T1)

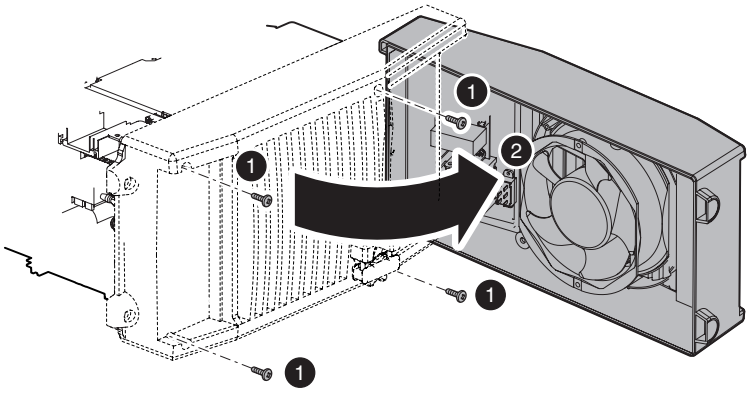
1) Remove the side cover. [Reference page: 9-1]
2) Cut off one snap band and disconnect one connector. Remove one screw and three ground terminals. Cut off two snap bands.



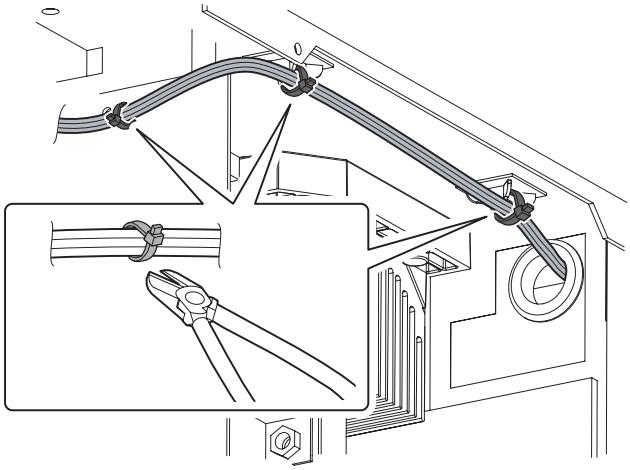
3) Cut the tap wires on the primary side of the transformer (T1), which are connected with the insulated terminal.
   • Incorrect wiring of each tap wire when reinstalling the transformer may damage the welding machine. Check the electrical schematic diagram before connecting the tap wires.



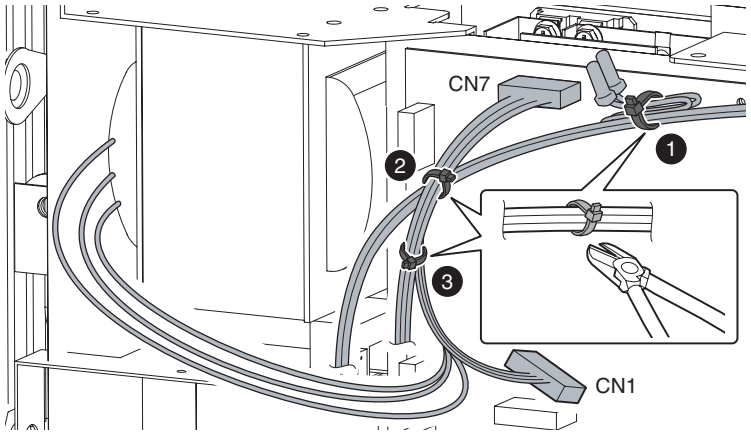
4) Remove four screws and open the rear cabinet.



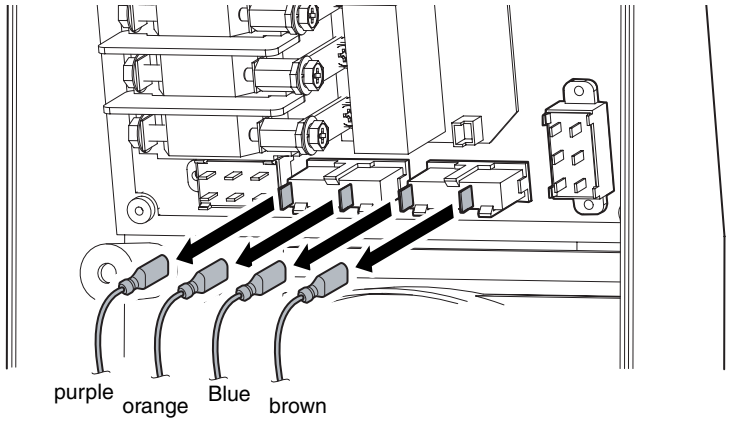
5) Cut off three snap bands.
   • When reinstalling the transformer, secure the harnesses to the holders using snap bands.



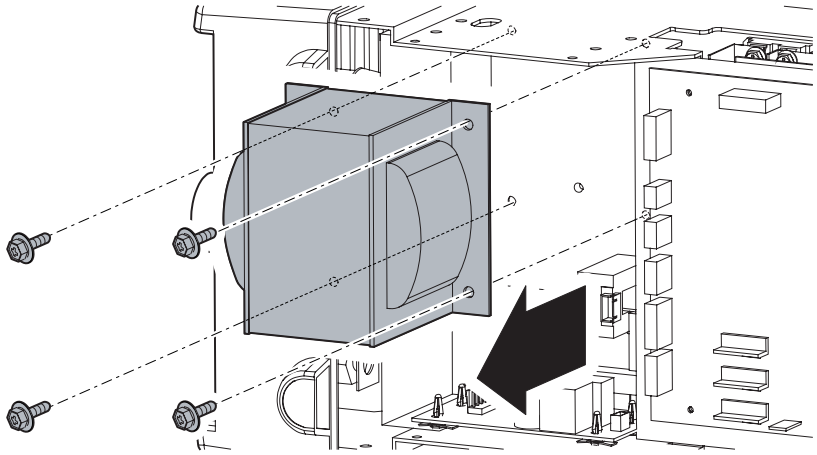
6) Cut off one snap band. Cut off one snap band that ties together the harness of CN7 on PCB17 (WK-5699) and the harness wired to the rear side. Cut off one snap band that ties together the harness on the secondary side of the transformer (T1) and the harnesses of CN7/CN1 on PCB17 (WK-5699).



7) Remove four terminals.

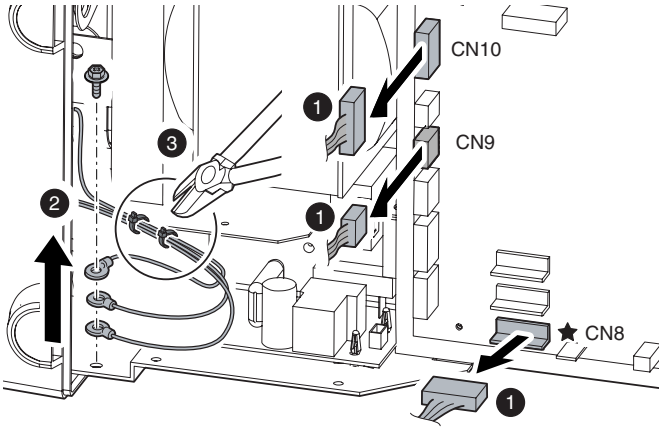


8) Remove four screws and remove the transformer (T1).

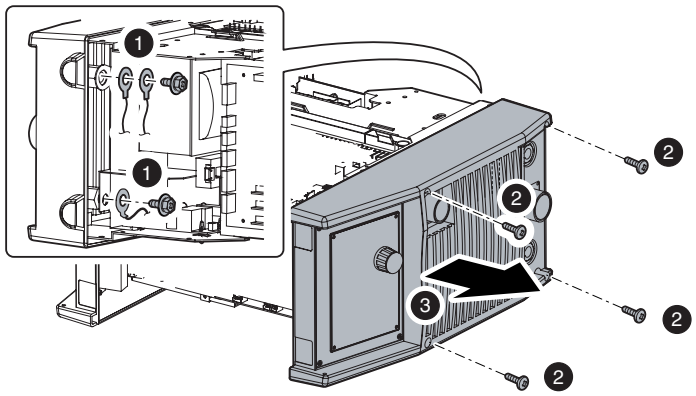


2.4.30 14-Pin Receptacle (CON1)

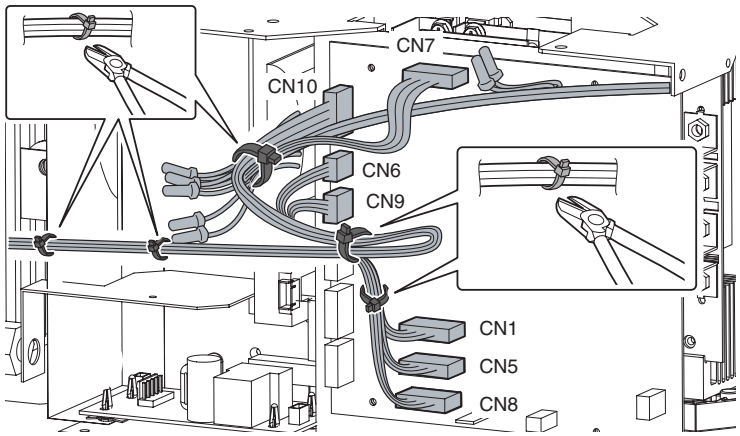
1) Remove the side cover. [Reference page: 9-1]
2) Disconnect three connectors. Remove one screw and three ground terminals. Cut off two snap bands.



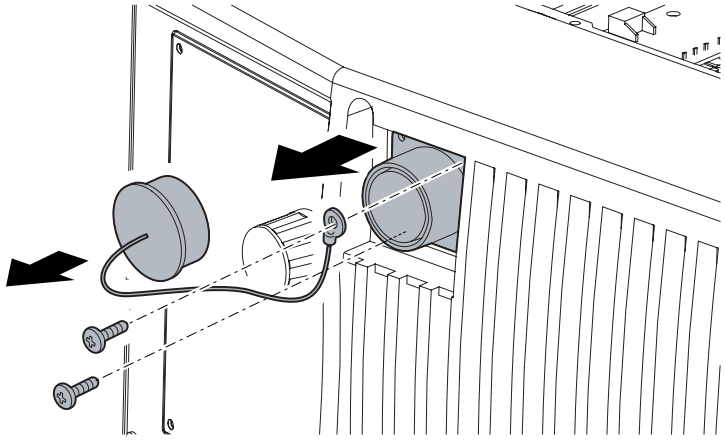
3) Remove two bolts and three terminals. Remove four terminals and open the front cabinet.



4) Cut off five snap bands.
   - When reinstalling the receptacle, bend both the harnesses of CN6/CN7/CN9/CN10 on PCB17 (WK-5699) and the ones of N-pin/L-pin of 19-pin receptacle (CON2), and then use snap bands to tie together the bent harnesses and the ones of CN1/CN5/CN8 on PCB17 (WK-5699).

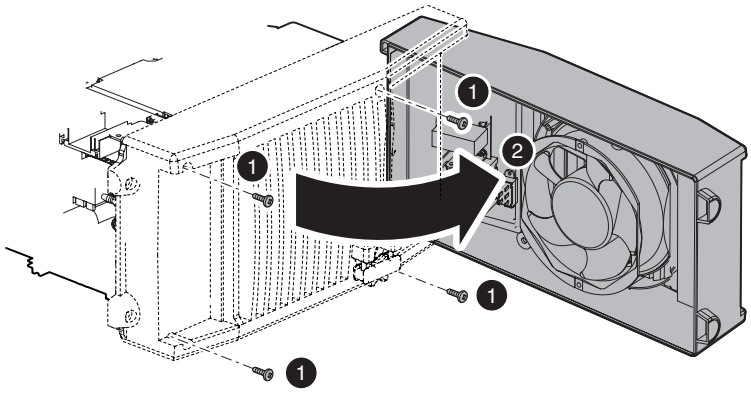


5) Remove two screws. Remove the cap and remove the 14-pin receptacle (CON1).

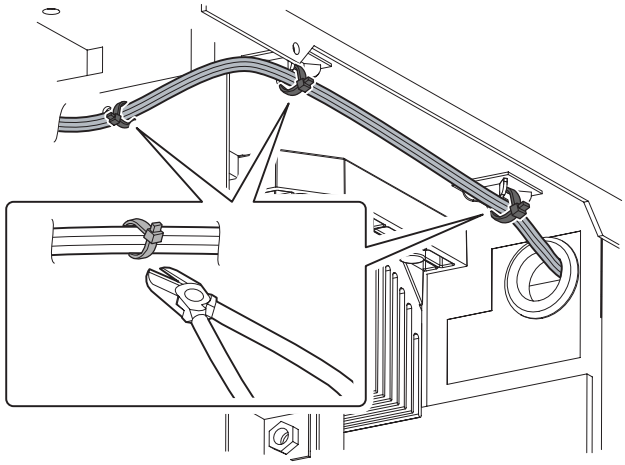


2.4.31 19-Pin Receptacle (CON2)

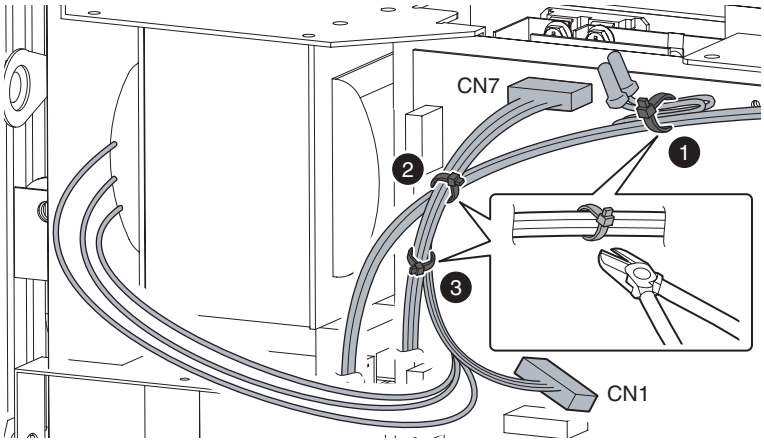
1) Remove the side cover. [Reference page: 9-1]
2) Remove four screws and open the rear cabinet.



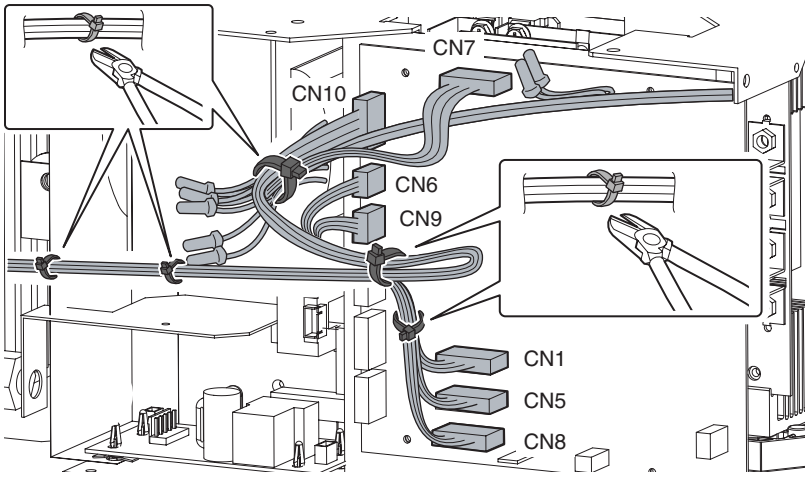
3) Cut off three snap bands.
   • When reinstalling the receptacle, secure the harnesses to the holders using snap bands.



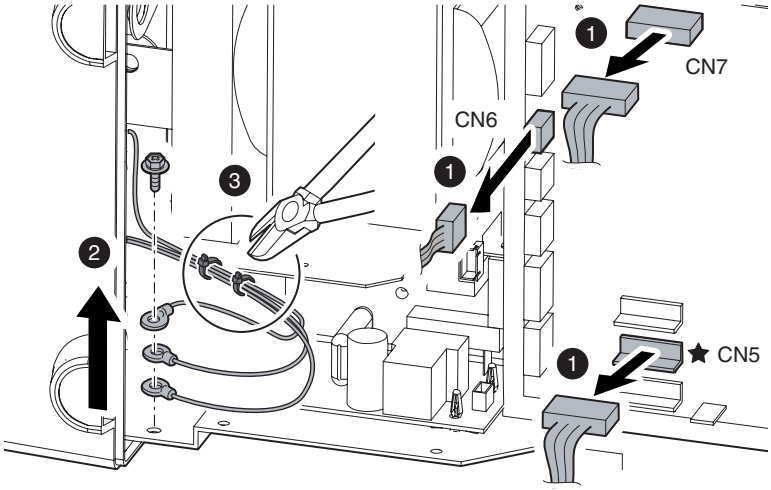
4) Cut off one snap band. Cut off one snap band that ties together the harness of CN7 on PCB17 (WK-5699) and the harness wired to the rear side. Cut off one snap band that ties together the harness on the secondary side of the transformer (T1) and the harness of CN7/CN1 on PCB17 (WK-5699).



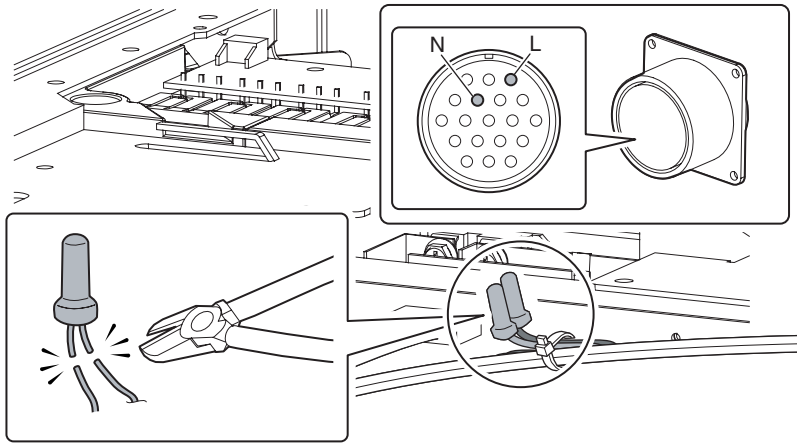
5) Remove five snap bands.
- When reinstalling the receptacle, bend both the harnesses of CN6/CN7/CN9/CN10 on PCB17 (WK-5699) and the ones of N-pin/L-pin of the 19-pin receptacle (CON2), and then use snap bands to tie together the bent harnesses and the ones of CN1/CN5/CN8 on PCB17 (WK-5699).



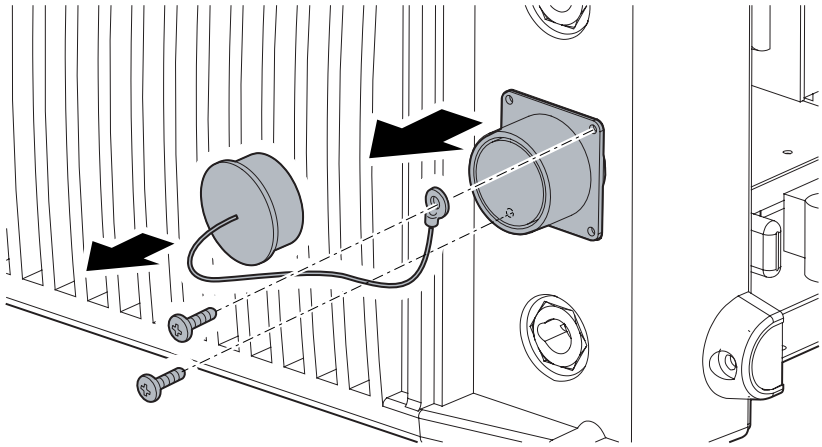
6) Disconnect three connectors. Remove one screw and three ground terminals. Cut off two snap bands.



7) Cut the harnesses of N-pin/L-pin of the 19-pin receptacle (CON2), which are connected with the insulated terminals.



8) Remove two screws. Remove the cap and remove the 19-pin receptacle (CON2).



APPENDIX 1 PARTS LIST

1 Equipment Identification

All identification numbers as described in the Introduction chapter must be furnished when ordering parts or making inquiries. This information is usually found on the nameplate attached to the equipment. Be sure to include any dash numbers following the Part or Assembly numbers.

2 How To Use This Parts List

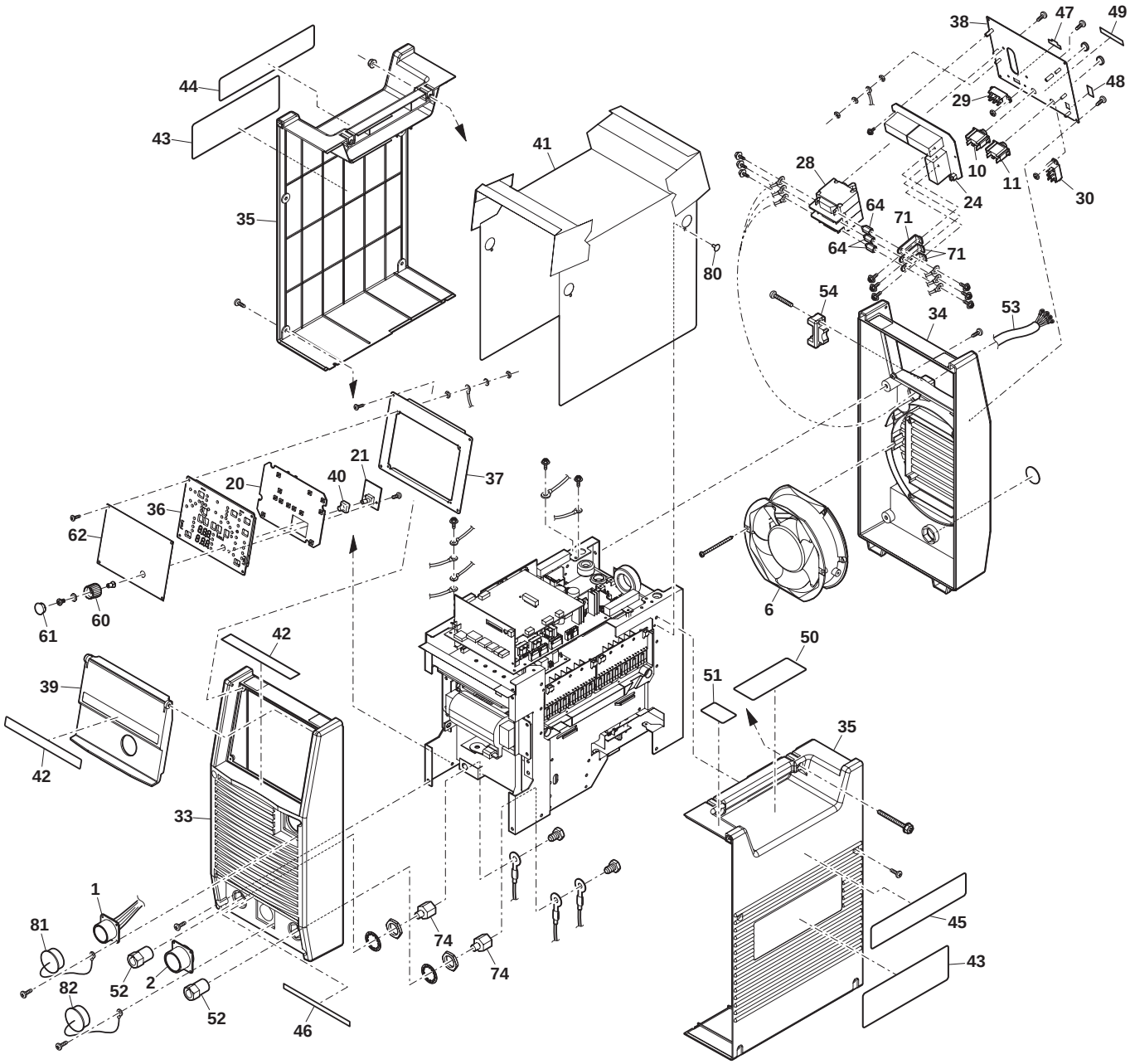
The Parts List is a combination of an illustration and a corresponding list of parts which contains a breakdown of the equipment into assemblies, subassemblies, and detail parts. All parts of the equipment are listed except for commercially available hardware, bulk items such as wire, cable, sleeving, tubing, etc., and permanently attached items which are soldered, riveted, or welded to other parts. The part descriptions may be indented to show part relationships. To determine the part number, description, quantity, or application of an item, simply locate the item in question from the illustration and refer to that item number in the corresponding Parts List.

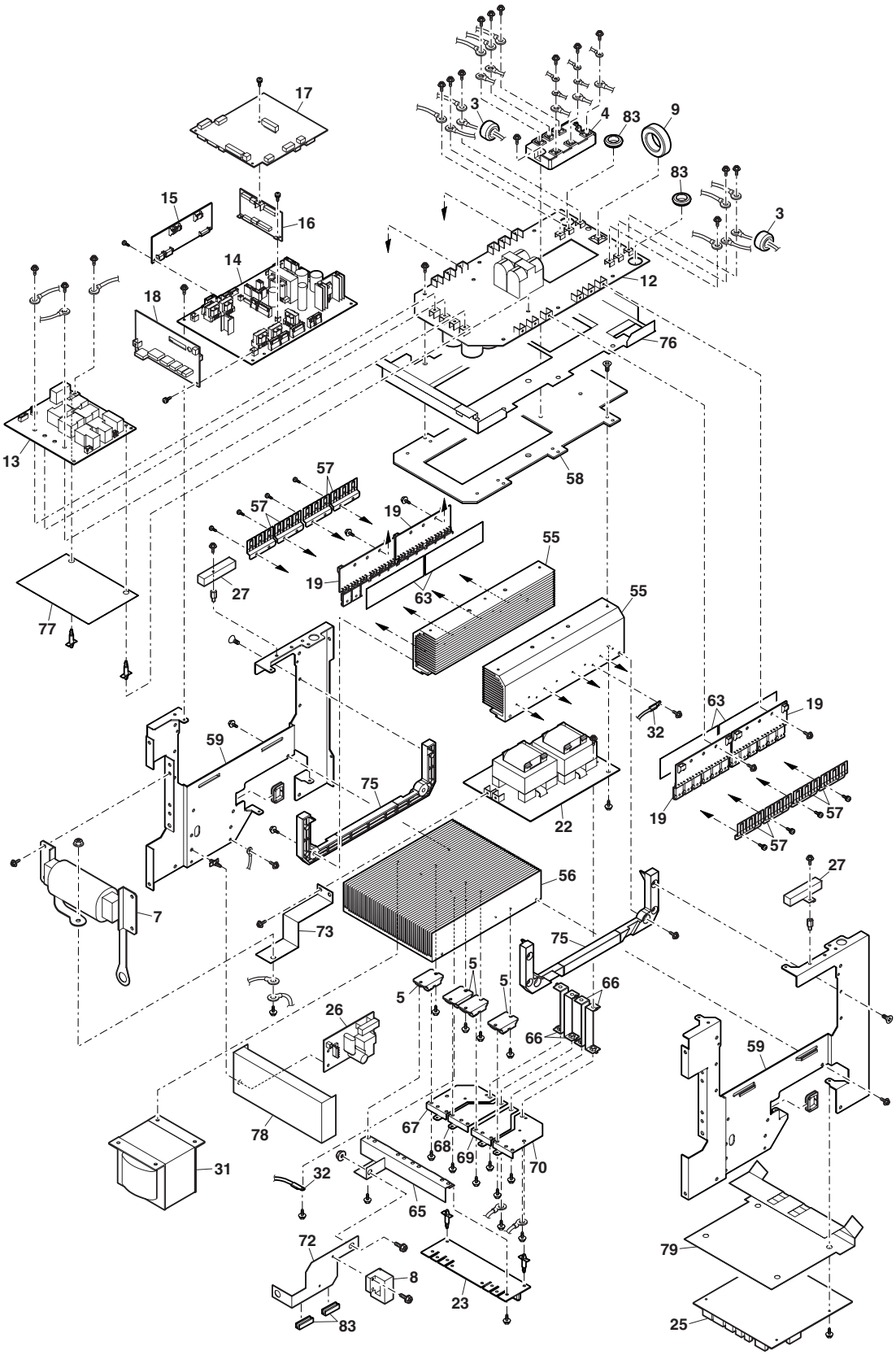
PART NUMBERS: ARC MASTER 400MST 10-3072

No.	DWG No.	Part No.	Description	Additional Information	QTY.
1	CON1	W7001302	Socket, Remote, gen 3.1, IPS	MS3102A20-27S (NIC) 14P (with Wiring Assembly)	1
2	CON2	W7001303	Socket, Remote, gen 3.1, IPS	MS3102A22-14S (NIC) 19P (with Wiring Assembly)	1
3	CT1-2	W7001304	Transformer, gen 3.1, IPS	F2A503001 CT 1:40	2
4	D1	10-6769	Diode, gen 3.1, IPS	DFA100BA160	1
5	D2-5	10-6629	Diode, gen 3.1, IPS	DBA200UA60	4
6	FAN1	W7001307	Fan, gen 3.1, IPS	109E5724H507 DC 24V 16.8W	1
7	FCH1	W7001308	Inductor, gen 3.1, IPS	F3A207601 400A MIG FCH	1
8	HCT1	10-5003	Sensor, Current, gen 3.1, IPS	HC-TN200V4B15M 200A 4V	1
9	L1	W7001309	Reactor, gen 3.1, IPS	GP-7	1
10	MCB1	W7001310	Circuit Breaker, gen 3.1, IPS	TBC5071-01-0820 1P 125V 2.5AT	1
11	MCB2	10-2235	Circuit Breaker, gen 3.1, IPS	TBC5071-20-1420 1P 125V 10AT	1
12	PCB1	W7001312	PCB, gen 3.1, IPS	WK-5493 U01 MAIN PCB	1
13	PCB2	W7001313	PCB, gen 3.1, IPS	WK-5597 U01 LINK PCB	1
14	PCB3	W7001314	PCB, gen 3.1, IPS	WK-5548 U01 DDC PCB	1
15	PCB4	10-6635	PCB, gen 3.1, IPS	WK-4819 U01 DETECT PCB	1
16	PCB5	W7001315	PCB, gen 3.1, IPS	WK-5696 U01 CONECT PCB	1
17	PCB6	W7001742	PCB, gen 3.1, IPS	WK-5688 U03-2 MIG CTRL PCB	1
18	PCB7	W7001317	PCB, gen 3.1, IPS	WK-5689 U01 FILTER PCB	1
19	PCB8-11	W7001318	PCB, gen 3.1, IPS	WK-5479 U01 GATE PCB (with	4
20	PCB12	W7001319	PCB, gen 3.1, IPS	WK-5527 U05 PANEL PCB	1
21	PCB13	W7001320	PCB, gen 3.1, IPS	WK-5528 U01 ENCODER PCB	1
22	PCB14	W7001321	PCB, gen 3.1, IPS	WK-5594 U01 TRANS PCB	1
23	PCB15	W7001322	PCB, gen 3.1, IPS	WK-5606 U01 DIODE SNUBBER PCB	1
24	PCB16	10-6740	PCB, gen 3.1, IPS	WK-4917 U04 INPUT FILTER PCB	1
25	PCB17	W7001323	PCB, gen 3.1, IPS	WK-5699 U01 14/19 CONNECT PCB	1
26	PCB18	W7001324	PCB, gen 3.1, IPS	WK-5499 U01 FILTER PCB	1
27	R2-3	W7001325	Resistor, gen 3.1, IPS	MHS20A151JI 20W 150OHM	2
28	S1	10-6857	Switch, gen 3.1, IPS	DCP-103SR100C-480V 3P-480V	1
29	S2	10-5222	Switch, gen 3.1, IPS	SDKGA4-A-1-A	1
30	S3	10-5222	Switch, gen 3.1, IPS	SDKGA4-A-1-A	1
31	T1	W7001326	Transformer, gen 3.1, IPS	F3A216701	1
32	TH1, 2	10-5228	Thermistor, gen 3.1, IPS	ERTA53D203 20kΩ/25°C B=3950K	2

No.	DWG No.	Part No.	Description	Additional Information	QTY.
33		W7001328	Panel, Front, gen 3.1, IPS	E0D006301	1
34		W7001329	Panel, Rear, gen 3.1, IPS	E0D004901	1
35		W7001330	Label, Side, gen 3.1, IPS	E0D005207	2
36		W7001331	Case, Front, gen 3.1, IPS	E0C346000	1
37		W7001332	Board, Front, gen 3.1, IPS	JEA496001	1
38		W7001333	Cover, Rear, gen 3.1, IPS	JDA788900	1
39		W7001334	Cover, Protector, gen 3.1, IPS	E0C299200	1
40		10-6791	Cover, Encoder, gen 3.1, IPS	EBA514400	1
41		W7001336	Cover, PCB, gen 3.1, IPS	E1B537600 (with Dustcover Sheet)	1
42		W7001718	Label, Name, gen 3.1, IPS	N4A831400 (400MST)	1
43		W7001338	Label, Side, gen 3.1, IPS	N4A785200	2
44		W7001339	Label, 1 Warning, gen 3.1, IPS	N1B029700	1
45		W7001340	Label, 2 Warning, gen 3.1, IPS	N1B029800	1
46		W7001341	Label, Output Terminal, gen 3.1,	N4A178600	1
47		W7001342	Label, Switch, gen 3.1, IPS	N4A146500	1
48		W7001343	Label, 14/19 Switch, gen 3.1, IPS	N4A311800	1
49		W7001344	Label, MCB, gen 3.1, IPS	N4A144200	1
50		W7001345	Label, VRD, gen 3.1, IPS	N4A919100	1
51		W7001511	Label, VRD, gen 3.1, IPS	N4A598700	1
52		10-6660	Terminal, Output, F, gen 3.1, IPS	TRAK-BE35-70S	2
53		N/A	Cable, Input, gen 3.1, IPS	SOOW AWG8X4C L=3.4m	1
54		10-6795	Clamp, Input, gen 3.1, IPS	EBA156800	1
55		W7001349	Heatsink, gen 3.1, IPS	E1B895000	2
56		W7001350	Heatsink, gen 3.1, IPS	E1B870100	1
57		W7001351	Spring Clip,IGBT, gen 3.1, IPS	E1B850100	8
58		W7001352	Chassis, PCB1, gen 3.1, IPS	J5B017500	1
59		W7001353	Chassis, gen 3.1, IPS	J3C356600	1
60		10-6665	Knob, gen 3.1, IPS	2621603	1
61		10-6666	Knob Cap, gen 3.1, IPS	3021104	1
62		W7001356	Cover, Protector, gen 3.1, IPS	N1B039200	1
63		W7001357	Sheet, Rubber, gen 3.1, IPS	EDA227700	4
64		W7001358	Post, 1(M5), gen 3.1, IPS	EBA643600 (M5-M5)	3
65		W7001359	Bus Bar, D, gen 3.1, IPS	EDA761400	1
66		W7001360	Bus Bar, T-D, gen 3.1, IPS	EDA003800	4
67		W7001361	Bus Bar, 1 D, gen 3.1, IPS	EDA046900	1
68		W7001362	Bus Bar, 2 D, gen 3.1, IPS	EDA047000	1
69		W7001363	Bus Bar, 3 D, gen 3.1, IPS	EDA047100	1
70		W7001364	Bus Bar, 4 D, gen 3.1, IPS	EDA047200	1
71		10-6868	Bus Bar, S1, gen 3.1, IPS	ECA321000	3
72		W7001366	Bus Bar, Output, gen 3.1, IPS	EDA761300	1
73		W7001367	Bus Bar, T-CC, gen 3.1, IPS	EDA047300	1
74		W7001368	Post, Output, gen 3.1, IPS	ECA867900	2
75		W7001369	Insulated Board, gen 3.1, IPS	E1B872000	2
76		W7001370	Insulation Sheet, gen 3.1, IPS	E1B859700	1
77		W7001371	Insulation Sheet, gen 3.1, IPS	EDA079800	1
78		W7001372	Cover, Protector, gen 3.1, IPS	E1B933900	1
79		W7001373	Cover, Protector, gen 3.1, IPS	E1B933100	1
80		W7001374	Clip, gen 3.1, IPS	#74 NATURAL	4
81		W7001375	Cover, CON1, gen 3.1, IPS	1070500-20 (with String)	1
82		10-6874	Cover, CON2, gen 3.1, IPS	97121-422R (with String)	1
83		W7001377	Edge Protect, gen 3.1, IPS	EH18U	2
84		10-2020	Plug, Output, gen 3.1, IPS	TRAK-SK50	1
85		300X4866	Operating Manual, gen 3.1, IPS	Operating Manual	1

400MST PARTS LIST

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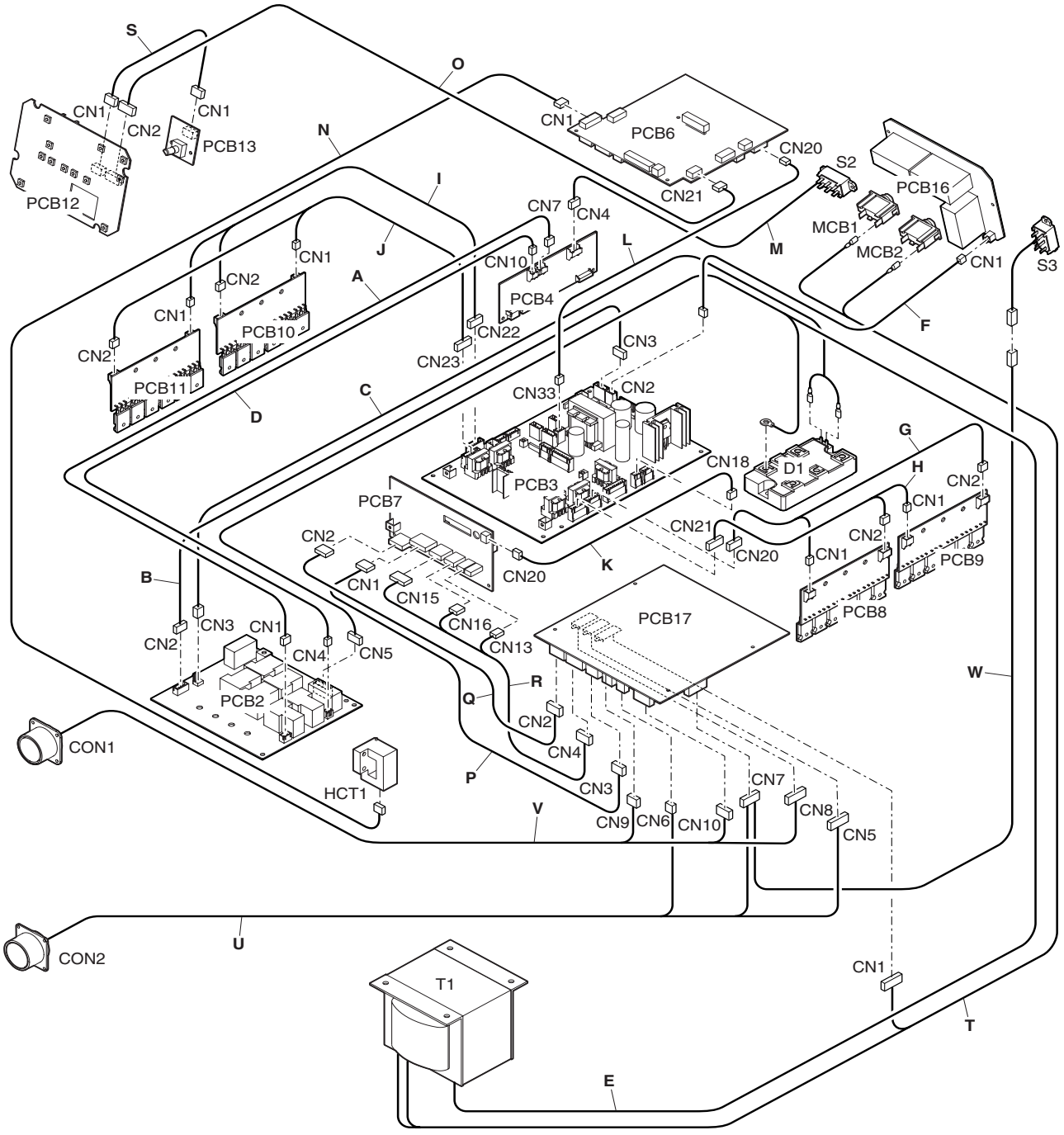
APPENDIX 2 CONNECTION WIRING GUIDE

	Destination					
A	PCB2	CN1	↔	PCB4	CN7	
B	PCB2	CN2	↔	PCB3	CN3	
C	PCB2	CN3	↔	D1		
D	PCB2	CN4	↔	PCB4	CN10	
E	PCB2	CN5	↔	D1		
				T1	230V	
				T1	460V	
F	PCB3	CN2	↔	PCB16	CN1	
G	PCB3	CN20	↔	PCB8	CN1	
				PCB9	CN2	
H	PCB3	CN21	↔	PCB8	CN2	
				PCB9	CN1	
I	PCB3	CN22	↔	PCB10	CN2	
				PCB11	CN1	

	Destination				
J	PCB3	CN23	↔	PCB10	CN1
				PCB11	CN2
K	PCB3	CN18	↔	PCB7	CN20
L	PCB3	CN33	↔	PCB6	CN20
M	PCB4	CN4	↔	S2	
N	PCB6	CN1	↔	HCT1	
O	PCB6	CN21	↔	PCB12	CN2
P	PCB7	CN1	↔	PCB17	CN3
Q	PCB7	CN2	↔	PCB17	CN2
R	PCB7	CN13	↔	PCB17	CN4
	PCB7	CN15			
	PCB7	CN16			
S	PCB12	CN1	↔	PCB13	CN1

	Destination				
T	PCB17	CN1	↔	T1	0V
				MCB1	
				MCB2	
U	PCB17	CN5	↔	CON2	
	PCB17	CN6			
	PCB17	CN7			
V	PCB17	CN8	↔	CON1	
	PCB17	CN9			
	PCB17	CN10			
W	PCB17	CN7	↔	S3	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PCB17
PCB2
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PCB9
MCB1
MCB2
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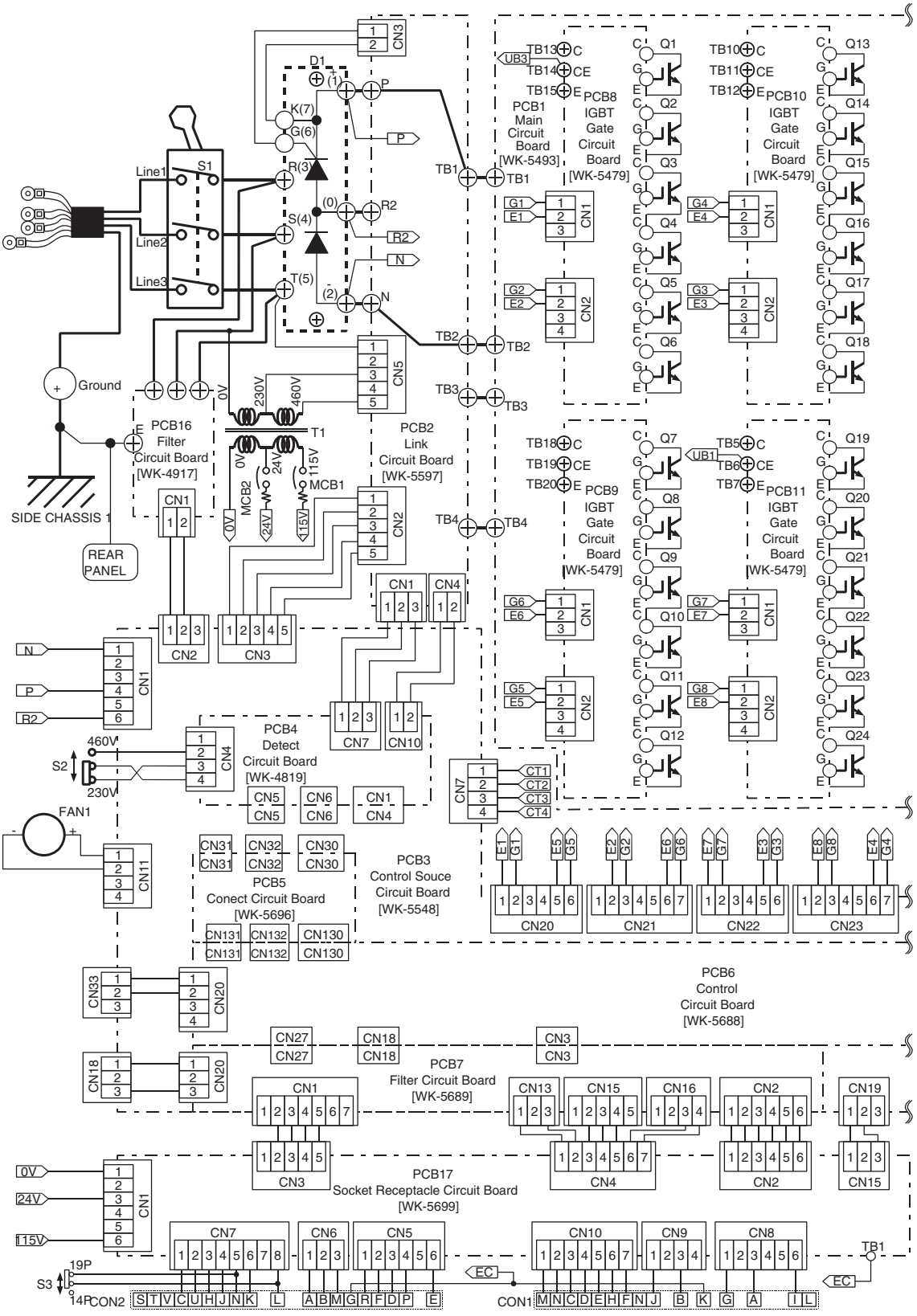
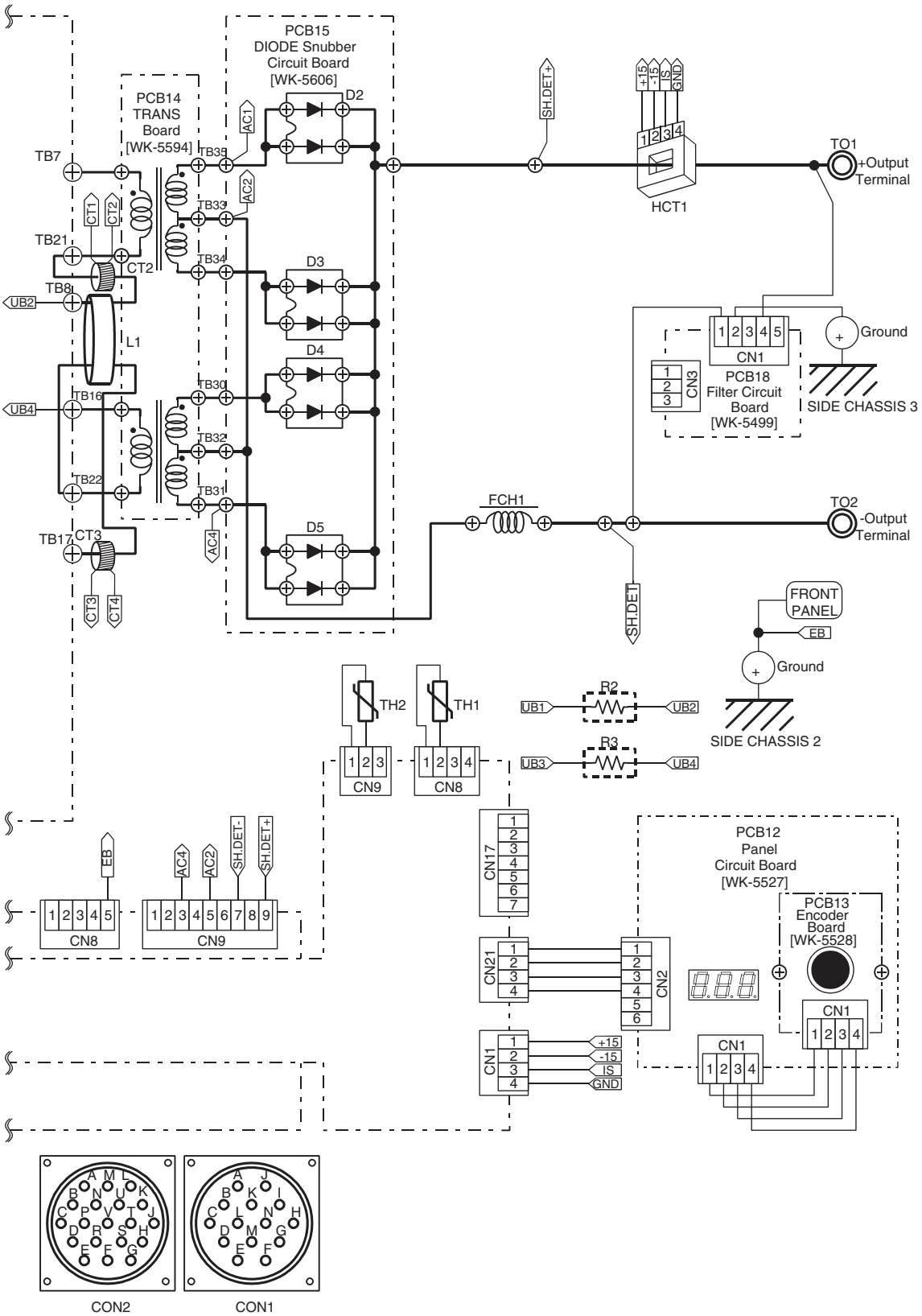
S3
D1
HCT1
T1
CON1
CON2
CN1
CN2
CN3
CN4
CN5
CN6
CN7
CN8
CN9
CN10
CN13
CN15
CN16
CN18
CN20
CN21
CN22
CN23
CN33

APPENDIX 3 INTERCONNECT DIAGRAM




PCB15
DIODE Snubber
Circuit Board
[WK-5606]
PCB14
TRANS
Board
[WK-5594]
TB7
TB21
TB8
UB2
L1
UB4
TB16
TB22
TB17
CT1
CT2
CT3
CT4
TB33
TB33
TB34
TB30
TB32
TB31
AC1
AC2
AC4
D2
D3
D4
D5
SH.DET+
+15
-15
IS
GND
HCT1
TO1
+Output
Terminal
CN1
CN3
PCB18
Filter Circuit
Board
[WK-5499]
Ground
SIDE CHASSIS 3
FCH1
TO2
-Output
Terminal
SH.DET-
FRONT
PANEL
EB
Ground
SIDE CHASSIS 2
TH2
TH1
CN9
CN8
R2
R3
UB1
UB2
UB3
UB4
CN17
CN21
CN2
CN1
PCB12
Panel
Circuit Board
[WK-5527]
PCB13
Encoder
Board
[WK-5528]
CON2
CON1

APPENDIX 4 DIODE TESTING BASICS

Testing of diode modules requires a digital Volt/ Ohmmeter that has a diode test scale.

1. Locate the diode module to be tested.
2. Remove cables from mounting studs on diodes to isolate them within the module.
3. Set the digital volt/ohm meter to the diode test scale.
4. Using figure 1 and 2, check each diode in the module. Each diode must be checked in both the forward bias (positive to negative) and reverse bias (negative to positive) direction.
5. To check the diode in the forward bias direction, connect the volt/ohm meter positive lead to the anode (positive, +) of the diode and the negative lead to the cathode (negative, –) of the diode (refer to Figure 10-1). A properly functioning diode will conduct in the forward bias direction, and will indicate between 0.3 and 0.9 volts.
6. To check the diode in the reverse bias direction, reverse the meter leads (refer to Figure 10-1). A properly functioning diode will block current flow in the reverse bias direction, and depending on the meter function, will indicate an open or "OL".
7. If any diode in the module tests as faulty, replace the diode module.
8. Reconnect all cables to the proper terminals.

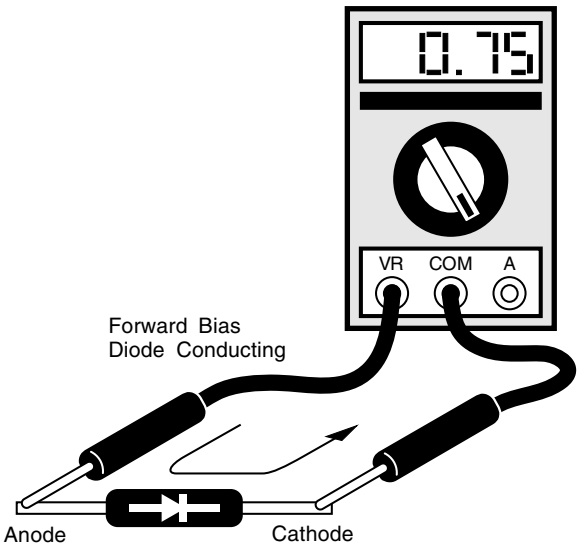


Figure 10-1: Forward bias diode test

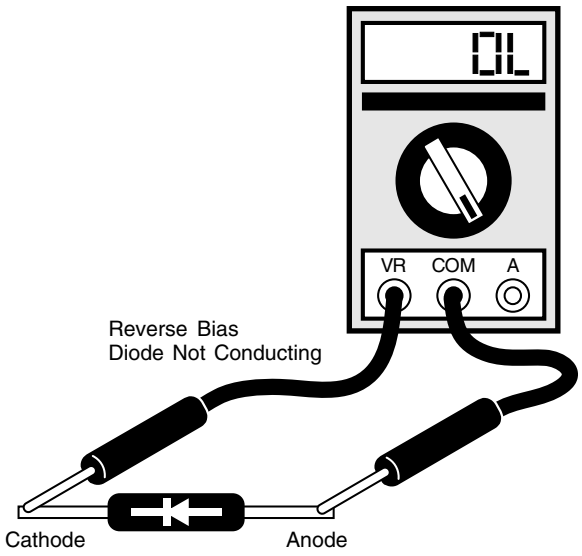


Figure 10-2: Reverse bias diode test

LIMITED WARRANTY

This information applies to Thermal Arc products that were purchased in the USA and Canada.

April 2006

LIMITED WARRANTY: Thermal Arc®, Inc., A Thermadyne Company ("Thermal Arc"), warrants to customers of authorized distributors ("Purchaser") that its products will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within the warranty period stated below, Thermal Arc shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal Arc's specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or damage, correct such defects by suitable repair or replacement, at Thermal Arc's sole option, of any components or parts of the product determined by Thermal Arc to be defective.

This warranty is exclusive and in lieu of any warranty of merchantability, fitness for any particular purpose, or other warranty of quality, whether express, implied, or statutory.

Limitation of liability: Thermal Arc shall not under any circumstances be liable for special, indirect, incidental, or consequential damages, including but not limited to lost profits and business interruption. The remedies of the purchaser set forth herein are exclusive, and the liability of Thermal Arc with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal Arc, whether arising out of contract, tort, including negligence or strict liability, or under any warranty, or otherwise, shall not exceed the price of the goods upon which such liability is based.

No employee, agent, or representative of Thermal Arc is authorized to change this warranty in any way or grant any other warranty, and Thermal Arc shall not be bound by any such attempt. Correction of non-conformities, in the manner and time provided herein, constitutes fulfillment of thermal's obligations to purchaser with respect to the product.

This warranty is void, and seller bears no liability hereunder, if purchaser used replacement parts or accessories which, in Thermal Arc's sole judgment, impaired the safety or performance of any Thermal Arc product. Purchaser's rights under this warranty are void if the product is sold to purchaser by unauthorized persons.

The warranty is effective for the time stated below beginning on the date that the authorized distributor delivers the products to the Purchaser. Notwithstanding the foregoing, in no event shall the warranty period extend more than the time stated plus one year from the date Thermal Arc delivered the product to the authorized distributor.

Warranty repairs or replacement claims under this limited warranty must be submitted to Thermal Arc via an authorized Thermal Arc repair facility within thirty (30) days of purchaser's discovery of any defect. Thermal Arc shall pay no transportation costs of any kind under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the Purchaser. All returned goods shall be at the Purchaser's risk and expense. This warranty dated April 1st 2006 supersedes all previous Thermal Arc warranties. Thermal Arc® is a Registered Trademark of Thermal Arc, Inc.

WARRANTY SCHEDULE

This information applies to Thermal Arc products that were purchased in the USA and Canada.

April 2006

ENGINE DRIVEN WELDERS	WARRANTY PERIOD	LABOR
Scout, Raider, Explorer		
Original Main Power Stators and Inductors	3 years	3 years
Original Main Power Rectifiers, Control P.C. Boards	3 years	3 years
All other original circuits and components including, but not limited to, relays, switches, contactors, solenoids, fans, power switch semi-conductors	1 year	1 year
Engines and associated components are NOT warranted by Thermal Arc, although most are warranted by the engine manufacturer	See the Engine's Warranty for Details	

GMAW/FCAW (MIG) WELDING EQUIPMENT	WARRANTY PERIOD	LABOR
Fabricator 131, 181; 190, 210, 251, 281; Fabstar 4030; PowerMaster 350, 350P, 500, 500P; Excelarc 6045. Wire Feeders; Ultrafeed, Portafeed		
Original Main Power Transformer and Inductor	5 years	3 years
Original Main Power Rectifiers, Control P.C. Boards, power switch semi-conductors	3 years	3 years
All other original circuits and components including, but not limited to, relays, switches, contactors, solenoids, fans, electric motors	1 year	1 year

GTAW (TIG) & MULTI-PROCESS INVERTER WELDING EQUIPMENT	WARRANTY PERIOD	LABOR
160TS, 300TS, 400TS, 185AC/DC, 200AC/DC, 300AC/DC, 400GTSW, 400MST, 300MST, 400MSTP		
Original Main Power Magnetics	5 years	3 years
Original Main Power Rectifiers, Control P.C. Boards, power switch semi-conductors	3 years	3 years
All other original circuits and components including, but not limited to, relays, switches, contactors, solenoids, fans, electric motors	1 year	1 year

PLASMA WELDING EQUIPMENT	WARRANTY PERIOD	LABOR
Ultima 150		
Original Main Power Magnetics	5 years	3 years
Original Main Power Rectifiers, Control P.C. Boards, power switch semi-conductors	3 years	3 years
Welding Console, Weld Controller, Weld Timer	3 years	3 years
All other original circuits and components including, but not limited to, relays, switches, contactors, solenoids, fans, electric motors, Coolant Recirculator.	1 year	1 year

SMAW (Stick) WELDING EQUIPMENT	WARRANTY PERIOD	LABOR
Dragster 85		
Original Main Power Magnetics	1 year	1 year
Original Main Power Rectifiers, Control P.C. Boards	1 year	1 year
All other original circuits and components including, but not limited to, relays, switches, contactors, solenoids, fans, power switch semi-conductors	1 year	1 year
160S, 300S, 400S		
Original Main Power Magnetics	5 years	3 years
Original Main Power Rectifiers, Control P.C. Boards	3 years	3 years
All other original circuits and components including, but not limited to, relays, switches, contactors, solenoids, fans, power switch semi-conductors	1 year	1 year

GENERAL ARC EQUIPMENT	WARRANTY PERIOD	LABOR
Water Recirculators	1 year	1 year
Plasma Welding Torches	180 days	180 days
Gas Regulators (Supplied with power sources)	180 days	Nil
MIG and TIG Torches (Supplied with power sources)	90 days	Nil
Replacement repair parts	90 days	Nil
MIG, TIG and Plasma welding torch consumable items	Nil	Nil

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